THE TELEGRAPHIC JOURNAL AND

Electrical Review.

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SCIENCE CLASS EXAMINATIONS.

IT may be stated generally that the questions set in examination papers on electrical subjects, especially for classes which are attended by the many rather than the select few, are certainly not calculated to encourage the student to prosecute his studies. Except in cases when the questions are set by men of practical experience, the examination-papers give one the impression that the object of the examination is to determine what the pupil does not know rather than what he does know. Why examiners cannot set questions of a nature which shall test the student's ability to apply his knowledge to practical advantage is a mystery, but that they generally seem incapable of doing so is evident to every practical man. We receive continually copies of examination-papers on electrical subjects, and we notice almost invariably that the higher the position the professor occupies as a theoretical teacher the more useless and unpractical are the questions he sets.

It is, we think, an undoubted fact that the large majority of the workers who have carried out scientific enterprises to a successful issue, that is to say, to the point at which they become useful auxiliaries to the comfort of mankind, have been workers who have not shone conspicuously in the domain of pure theory. There are, of course, brilliant exceptions, but this is the most that can be said.

We have before us an examination paper on magnetism and electricity in connection with the science classes at South Kensington, and after reading through the questions set for the "Honcurs" examination, we unhesitatingly say that a very small percentage of the members of the Society of Telegraph Engineers and of Electricians would have been able to pass the examination had they all elected to undergo the test of their knowledge.

The examiners would seem to think that the more difficult and vague the question the more does it test the ability of the student and the more does it prove his capability of turning his knowledge to a useful account. The replies to the questions may probably prove the pupils' ability to instruct others in the theory of the subject, but that this is the ultimate object of the teaching few would be prepared to admit. It may be, however, that the examiners occasionally set questions on which they themselves are in doubt, and that from the numerous and varying answers sent in the Professors may fall across something which supplies the longed-for missing link to their own ideas.

Provisional Orders for Electric Lighting.—The Edison Electric Light Company, which had applied to the Board of Trade for a Provisional Order for the supply of electricity to the Holborn district, has, we understand, withdrawn its application.

THE ELECTRIC DYNAMOGRAPH, OR APPARATUS REGISTERING THE WORK OF MACHINES.

By M. C. RESIO.

IN a memoir presented to the Academy of Sciences, March 27th, 1882, I gave the description of an apparatus indicating the work of machines by means of a telephone, which, showing the torsion of the motor axle and its angular speed at the moment when the apparatus is examined, gives the elements necessary for calculating the work of the machine to which it is applied.

I have studied another apparatus which can register automatically, a curve of which the ordinates are proportional to the strain applied to the motor axle, and the abscissæ are proportionate to its angular speed. Hence the area contained between any two ordinates, the curve and the axis of the abscissæ gives the work of the machine in the time during which the diagram has been traced.

The dynamograph is composed of two parts, the transmitter and the receiver or registrar. The transmitter consists in a very simple mechanical arrangement, adapted to the motor axis, and by means of which the torsion simply causes a ring fitting on the axle to slip in the direction of its length, so that its displacements may be proportional to its length. A metallic stem with a rectangular section is placed at the side of the ring parallel to the axle and receives between two small clips affixed to its middle a flat edge of the ring, the plane of which is perpendicular to the axle. It follows that the stem must follow all the movements of the ring, and its displacements which are parallel to the axle are also proportional to the torsion. If to this stem we adapt an index, the point of which is above a fixed scale, its position shows at any moment the torsion and consequently the strain of the motor. The movements of this index are transmitted electrically, as well as the angular velocity, of the axle to the registering apparatus, which traces a curve, the ordinates of which are proportionate to its displacements from the zero or point corresponding to no torsion; the abscissæ are proportionate to the angular velocity.

The mechanical arrangement to effect this transmission is composed of a clock which directs each minute two electric currents into a circuit, so that the time which has elapsed between two consecutive emissions is exactly proportional to the displacement of the index, and consequently to the motor strain; this time is always less than sixty seconds.

In the receiver, that part of the mechanism which serves to register the torsion is also composed of a clock, which communicates to a cylinder, having in relief upon its surface the thread of a screw continually inked, a uniform rotary movement, so as to make a revolution in sixty seconds. This cylinder is not fixed upon its axle, but rests upon it with a gentle friction; hence it may be stopped without the axle ceasing to turn. At the first emission of the current directed into the circuit which connects the transmitter and receiver, the screw begins to turn; at the second emission a slip of paper, which uncoils slowly at a rate proportional to that of the machine, passing under and very near the thread of the screw, is brought sharply, by the action of an electro-magnet, into contact with the thread, and a trace of ink is made upon the paper. Since at the first emission another trace is produced upon the paper, it is evident that the distance of the two traces is proportional to the time elapsing between the two emissions of the current, and consequently to the torsion or to the strain applied to the motor axle. The first ink-mark is always produced at the moment when the rotation of the screw begins. As these marks follow each other very closely, the movement of the paper being slow, they form a right line parallel to the margin of the paper. The traces due to the second emission give rise to a curve, the co-ordinates of which will be the distances indicated above, and consequently will be proportional to the torsion and to the motor strain. If the speed at which the paper is carried along is proportional to the angular velocity of the axle, we shall have a curve showing the work of the machine to which the dynamograph is applied. Its mechanical arrangement for this purpose is very simple.—*Comptes Rendus.*

ELECTRIC LIGHTING SYSTEMS.

IN the report of the meeting of the Maxim-Weston Electric Light Company, to be found in our other columns, will be seen a letter emanating from Mr. N. de Kabath. We fancy that this epistle will cause a considerable amount of amusement to the proprietors of other systems of electric lighting. It is certainly news to Englishmen to know that Messrs. Weston and Maxim are the "ablest electricians living to-day." That the Weston dynamo-electric machines yield 15 per cent. more current than any other; that the Weston arc lamp has established its superiority, and that the Maxim incandescence lamp is considered everywhere as the best in the market is also calculated to cause great surprise, not to say consternation, amongst other companies, which up to the present time had fondly believed that they possessed at least equally good apparatus.

Mr. N. de Kabath's remarks on the probable cause of the Maxim-Weston Company's awkward position are characteristic. He may not know what constitutes good or bad management, but he evidently knows the value of money. In regard to the management of the company, however, Mr. de Kabath apparently contradicts himself in the next paragraph, for he asserts that the company has been seeking after the unattainable. The object of this letter, which was read to the meeting of the shareholders, is patent to every one, and Mr. de Kabath's modesty—being himself the owner of some inventions and the representative of the Maxim-Weston systems in Europe—in not criticising other systems on the ground that his opinion would not be considered an impartial one is most commendable. Some persons, however, might be sceptical enough to think that his opinion as to the "ablest electricians living to-day" is somewhat biassed.

The prospects of the Maxim-Weston Company will certainly not be improved by communications of such a character as the document we call attention to, as its absurdities are all too palpable, and England—well, is not America.

M. REYNIER'S ACCUMULATORS.

IN the ELECTRICAL REVIEW for March 24th we gave a description of the Electric Light installation at Nantua (department of the Ain), arranged by M. Emile Reynier, in which accumulators of his own design were successfully employed. The following explanation and illustration of these, which the inventor himself supplied to our contemporary, *L'Electricien*, may be of interest.

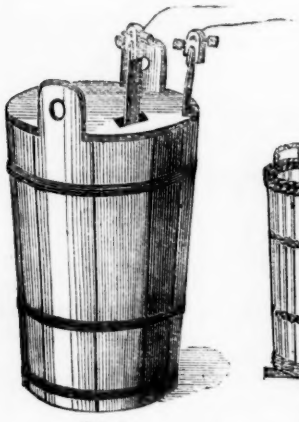


Fig. 1.

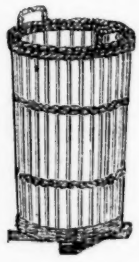


Fig. 2

Fig 3

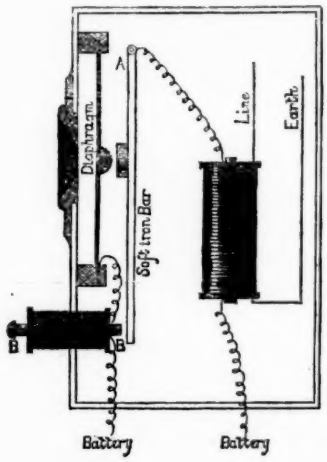
The Nantua model (figs. 1, 2, and 3) has rendered and will render some service; but it is destined to give place to less clumsy and cumbersome types. It consists of a Planté positive of peroxydised lead, with considerable surface (fig. 3), corrugated and perforated, supported on a wooden framework, and a negative of lead coated with copper or zinc, lining the recipient. The two electrodes are insulated from the bottom by a wooden cross-bar, and separated from one another by a wicker cage (fig. 2). The whole is enclosed in a deal bucket, tarred over inside, and bound round with metal bands (fig. 1).

The liquid is dilute sulphuric acid, holding in solution sulphate of zinc or sulphate of copper. The electromotive force is 1·68 volts in the copper couple, and 2·3 volts in the zinc couple. The latter is therefore much more powerful than the former; but in its negative is developed a local action which diminishes its efficiency.

The accumulators were 36 in number, 18 zinc, and 18 copper; total electromotive force 71 volts; resistance ·9 ohms. Each accumulator weighs 22 kilos, and is capable of storing 300,000 coulombs.

TELEPHONE TRANSMITTERS.

SINCE the erection of the steel-copper overhead wire between New York and Chicago various systems of telephone transmitters and receivers have been experimented with over the 1000 or more miles covered by this line. Some of these instruments have been referred to both in our articles and in our correspondence columns. The *Electrical World* of New York, dated April 28th, contains interesting descriptions and illustrations of several well-known systems recently tested on the above line, from which we extract that known as the Baxter transmitter.



Its general construction is substantially as follows:—

To the diaphragm a small round piece of platinum is made fast. The diaphragm itself is secured in a similar manner to that of the Blake transmitter, namely, with two stiff pieces of spring, or spring fingers. Directly over the face of the diaphragm is suspended a bar of soft iron, this bar swinging freely on a fulcrum, A. Normally, the bar lies by its own weight against the diaphragm. Directly in the centre of the bar a carbon button is secured, pressing—by the weight of the iron bar—against the platinum ball secured to the diaphragm. The iron bar resting thus, the diaphragm would not be sufficient for an adjustment where loud tones would be used, as the result in that case would be the same as in the Blake or any other microphone transmitter when spoken into with any force, for it would break or rupture the continuity of the circuit irregularly. The adjustment is therefore obtained as follows:—A small coil, C, is placed directly opposite the free end of the iron bar, this coil being supplied with a long movable core. The wire of this coil forms a part of the primary circuit with the induction coil and the transmitter, and the same battery is used for both, so that immediately the battery is applied the movable core becomes slightly magnetic and creates, according to the position of the core to the suspended bar, a magnetic field, the strength of which is changed according to the advancing or withdrawing of the core to or from the end of the iron bar.

MINCHIN'S ABSOLUTE SINE ELECTROMETER.

WE give a description of the second of these instruments, which has just been constructed by Mr. W. Groves, of Bolsover Street, London, for Professor Anthony, of Cornell University, N.Y. It is very handy, and in several respects an improvement on that which was constructed for Professor Minchin, experience having demonstrated to Mr. Groves the difficulties of construction and of subsequent working which are to be met, and we think that all material difficulties have been anticipated and removed in the present instrument.

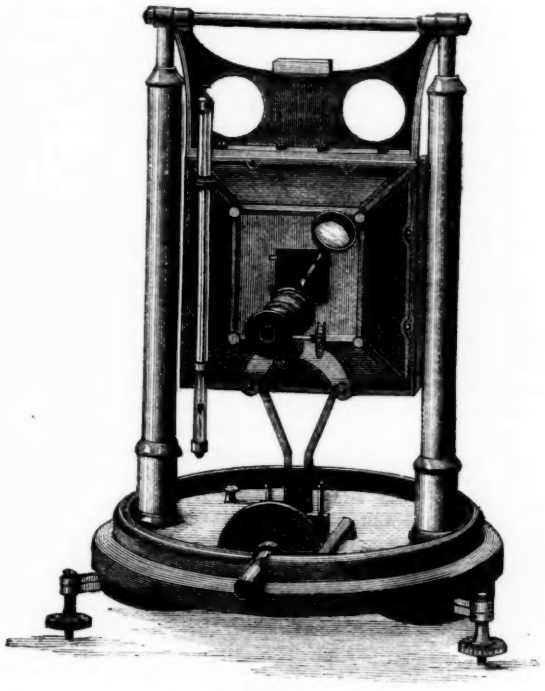


FIG. 1.

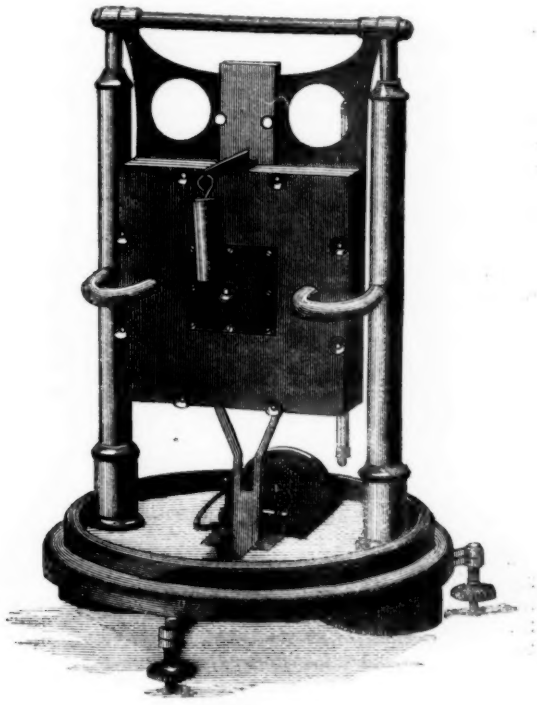


FIG. 2.

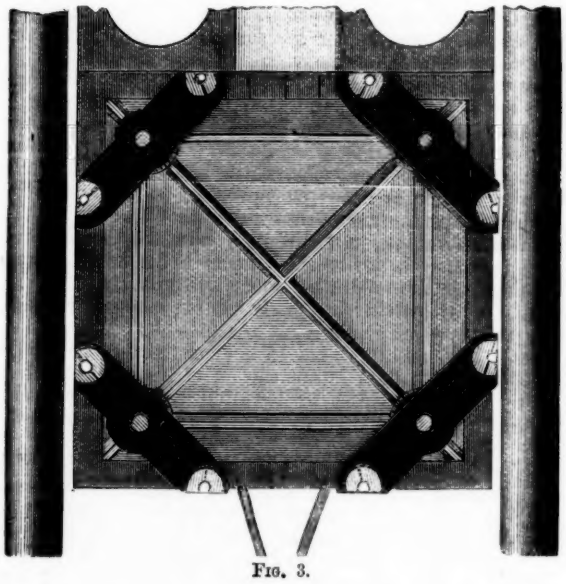


FIG. 3.

Fig. 1 represents the front view of the instrument, fig. 2 the back, and fig. 3 also the back, with the case removed, to show the insulated plate, which is adjustable by means of the screws in the ebonite clips. The instrument consists essentially of a pair of plates, having their plane surfaces opposed, and separated by a distance of half a millimètre, or one millimètre, as may be desired. The plates are insulated one from the other. They are vertically mounted, the upper edges being jointed to two pillars to allow of their swinging. To the lower edge of the plates an arm is fixed, upon which the point of a micrometer screw presses for the purpose of tilting it. In the centre of one of the plates (the earth-plate) a square aperture is made, which is fitted flush with a light aluminum disc suspended by silk fibres and a "Wollaston" platinum wire to the upper edge of the plate. Grooves are made on the plate to clear the wires. At right angles to the earth-plate a microscope is fixed, having a high power object-glass to focus marks upon the aluminum disc, which disappear when the disc is attracted by the opposite plate. To the back plate a weight is attached to keep it in contact with the point of the micrometer screw. An air communication is made between the case containing the insulated plate and two lead bottles containing sulphuric acid by india-rubber tubes and the pillars which are hollow, to dry the air in the case. The micrometer screw has 60 threads to the inch, and the head is divided into 1,000 parts. A plumb line in a glass tube is attached to get the vertical position of the instrument.

Theory of the Instrument.

Let us suppose the system of plates tilted out of the vertical, so that the plane of each plate makes an angle, θ, with the vertical.

In the accompanying figure, let *a* represent the horizontal axis, round which the two plates turn as one system; let C represent the continuous plate; D, the disc, whose weight is

W; let p represent the threads suspending the disc from the top, r, of the guard-plate; let s represent the axis of the micrometer screw, whose head is M.

Now, suppose C to be metallically connected with a conductor or battery pole, whose potential is V, while the guard-plate (and with it the disc, D) is connected with earth.

Then the charge on the continuous plate, C, will produce a normal force, N, on the disc; and in any random position D will be in equilibrium under the action of N, W, the tensions of the suspending threads, and the reactions of the screws which keep D flush with the surface of the guard-plate. Suppose, now, that we tilt the plates round a to such an extent that the disc is just about to leave its flush position, then the reactions of the screws at its back vanish, and if we resolve the forces keeping it in equilibrium perpendicularly to its plane we have simply—

$$N = W.\sin\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

If θ is small, we may put θ (circular measure) for sin θ, so that

$$N = W.\theta$$

Let S = area of disc in square centimètres, d = distance between the plates in centimètres, and V the difference of potential of the plates in absolute electrostatic measure; then it is well known that

$$N = \frac{SV^2}{8\pi d^2}$$

$$\therefore \frac{SV^2}{8\pi d^2} = W.\theta. \quad . \quad . \quad . \quad . \quad . \quad (2).$$

Practically the distance, d, will be one millimètre or half millimètre, and W will be determined in grammes, whereas in (2) it is supposed to be expressed in *dynes*. Assuming, then, that d is in millimètres and W in *dynes* (2) will become

$$V = d\sqrt{78{\cdot}48\,\frac{\pi W\theta}{S}} \quad . \quad . \quad . \quad . \quad (3).$$

In the present instrument the pitch of the micrometer screw is 1-60 inch, so that if in reaching the limiting position of equilibrium, the head, M, of the screw has made m turns, its axis will have moved through $\frac{m}{60}$ inches; and, moreover, the distance between the centre of the axis, a, and the point at which the screw abuts against the plate, C, is 15 inches; hence

$$\tan\theta = \frac{m}{900}, \text{ or } \theta = \frac{m}{900};$$

hence (3) becomes

$$V = d\sqrt{{\cdot}274\,\frac{mW}{S}} \quad . \quad . \quad . \quad . \quad (4).$$

Now it is difficult to know when the planes of the plates are exactly vertical, *i.e.*, it is difficult to determine the origin of θ or m. Hence we must resort to a *differential method*, which obviates all difficulty.

Suppose that we have any number of cells, the *ratios* of whose E.M.F.'s we can easily find by means of a Thomson quadrant electrometer. Let the total E.M.F. of one batch of these (say five or six of them) be n E, and the total E.M.F. of another batch of them (say 20 or 30, or any higher number) be n' E; also let m and m' be the numbers (both unknown) of the turns of the screw corresponding to the limiting equilibrium positions of the disc, then we know Δ or m'-m, although m' and m are separately unknown. Hence (4) gives

$$E = \frac{d}{\sqrt{m'^2 - m^2}} \cdot \sqrt{{\cdot}274\,\frac{\Delta W}{S}} \quad . \quad (5).$$

which determines E, and therefore the E.M.F. of each cell separately in absolute measure.

It may occur to the reader that the force of "stiction" between the disc and the screws which keep it flush with guard-plate would introduce an error, but this objection is groundless, inasmuch as the force can be completely avoided. We can always very soon reach a position which is very near the limiting one; the slightest tap on the table is sufficient to cause the disc to shake in this position, and if it moves slightly out of focus (*i.e.*, out of contact with the screws, so that stiction = 0) we have only to turn the micrometer screw slightly and catch up the disc in focus again. In this way we arrive at the limiting position of equilibrium without the intervention of stiction.

The present instrument is in several respects a great improvement on that made some time ago for Professor Minchin, and with which the Professor determined the E.M.F. of a "gravity" form of Daniell's cell to be ·00352 absolute units. It is expected that the greatly improved arrangement for lighting up the disc and for drying the air, adopted in the new instrument, will render it extremely easy to use; but as it has only just been completed, no experiment has yet been made.

REVIEWS.

Formulaire pratique de l'Electricien. Par E. HOSPITALIER, &c. Paris: G. Masson.

MR. HOSPITALIER has most opportunely stepped in to supply a want which is, at this moment, much felt amongst electricians—namely, a concise and reliable collection of tables and formulæ embracing the new developments of practical electrical science. The volume before us follows very closely in the lines of the tables and formulæ issued about twelve years ago by L. Clark and R. Sabine; but much in that work which in the course of time has become obsolete, or has been improved out of the category of requisite reference-knowledge, has been omitted by Mr. Hospitalier, and a great deal of more modern and useful matter introduced. Whether this process has been carried by our author to such an extent as is desirable is however open to question. For instance, the reproduction of the table of obsolete units of resistance at page 41 will be thought worse than useless, because it is a waste of a whole page which might have been devoted to a better and more useful purpose. The table in question, which was published originally by Mr. F. Jenkin in the Jury Report of the 1862 Exhibition, was then of some interest, as giving some approximate comparison between several old units which had been in use, but the greater number of which were even then falling, if they had not actually fallen, into absolute disuse. One-and-twenty years afterwards such a resurrection of this old table might appear in an historical survey of the unit question, but it is altogether out of place in a book of tables and formulæ intended for everyday use; whether also the two pages devoted to the values of French and foreign moneys are pages devoted to the best and most useful purpose for the electrician, is, to our mind, doubtful. Much the same occurs to us with regard to some of the other tables. In the majority of engineer's pocket-books, such as we meet with them nowadays, there is a great deal of information which is handy enough when it happens to be wanted, just as the mouse-trap which the White Knight set on his horse's saddle, in "Alice in Wonderland," would have been extremely handy to catch mice in the event of any running over the saddle, but which was probably rarely the case. Mr. Hospitalier has wisely left out most of this padding matter which engineering pocket-books contain sometimes to a liberal extent, but to our taste he has not gone far enough, and in a future edition of his excellent work we trust that the space we have indicated may be taken possession of by matter of more practical and frequent application.

Of the newer matter Mr. Hospitalier has given very useful and valuable information regarding generators, motors, lamps, &c., and of the recent testing apparatus; although in this regard, we think, had he added a little more detail—with perhaps an illustration or two, such as those he has devoted to keys and commutators in an earlier part of the book—to the best of the measuring instruments and omitted altogether those which in practice have been found to be unreliable, his book would have been still further improved. A little more amplification of the portion relating to electric lighting would be desirable. We think that such tables should embrace the simple formulæ for and simple descriptions of the instruments used to take indicator diagrams and also something about power dyna-

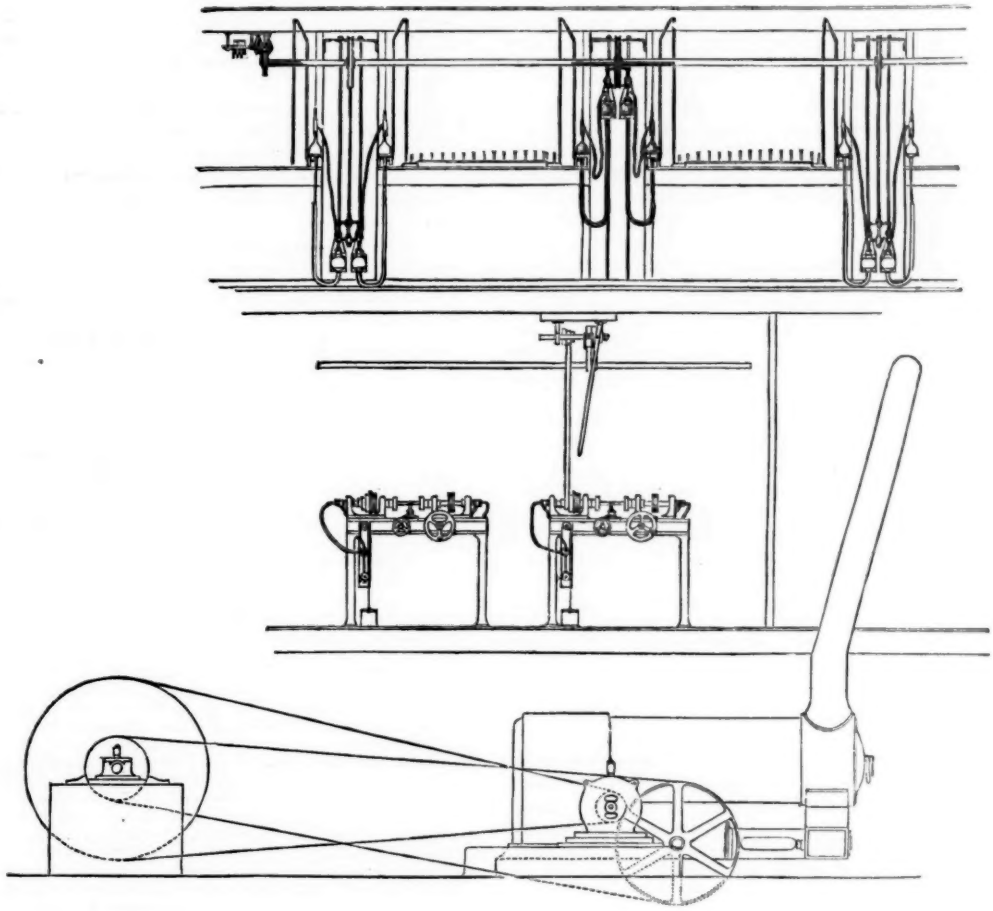
mometers because the power given to the dynamo is essential to a judgment of its efficiency. Then we think that the subject of photometry is entitled to more space than the few lines which only tell us in what unit light is measured in England, France, and Germany. The Prony-brake, also so essential in testing motors, should have a few lines and its formulæ in a book of this kind.

We have made these suggestions with no ill-natured intention. We greatly appreciate what Mr. Hospitalier has done; we have, during the few days his "Formulaire pratique" has been in our hands, profited by it in practice and can recommend our readers to do so too. Some of our readers may find that the want of numerical examples will be a source of difficulty to them. Unfortunately the present generation of men who class themselves as "electricians" is a wide one in point of fundamental education as well as of special training, and there are no doubt many *soi-disant* electricians who have mastered amongst other things the first four rules of arithmetic and can follow a numeral example, but to whom an algebraical formula is so much Greek. The compiler of any engineer's vade-mecum, while supplying the information requisite for the engineer's use, cannot be expected to supply every reader with the capacity to comprehend it. Such a work as the one before us cannot in its available space teach rudiments; it can only contain that which an educated man may be supposed to know, but which his memory may not be trusted to retain in every detail. And such an object Mr. Hospitalier's book is, we think, well calculated to fulfil.

THE MANUFACTURE OF INCANDESCENCE ELECTRIC LAMPS.

In the ELECTRICAL REVIEW for January 20th and March 3rd of the present year we gave two fully illustrated articles on Wright and Mackie's mechanical glass-blower.

Although the apparatus which we then described was suitable for any kind of glass-blowing, the machines were more intended for use in the manufacture of bulbs for incandescence electric lamps. Last week we inspected these machines in practical operation at Messrs. Wright and Mackie's factory, at 36 and 37, Bermondsey Street, S.E. This factory was fitted up for the Hammond Electric Light and Power Supply Company (Limited) to demonstrate on a commercial scale the utility and great economy dependent on these inventions. The above-named gentlemen early recognised the importance of reducing to the greatest possible extent the prime cost of incandescence lamps, and their energies, devoted to the substitution of machine for hand labour, have been successful in devising machinery by means of which the glass-work which forms one of the principal items in the cost of such lamps can be produced in a far cheaper and more efficient manner than heretofore. In



point of fact, this class of work depended upon a very small body of highly paid, skilled, and very independent artisans, whose occupation, owing to the severe strain put upon the lungs, is not a healthy one.

The factory at Bermondsey Street consists of four floors and is arranged as follows:—

ENGINE AND MACHINE ROOM.

In the basement is fixed an 8 horse-power nominal semi-fixed Marshall compound expansive engine of the latest type, with patent automatic expansion valve gear to high pressure cylinder, working at 180 revolutions per minute and rotating a 3-inch steel countershaft, from which the power is transmitted to the 300-light Ferranti alternate current machine with Siemens' exciter, and a 600 volt Siemens' alternate current machine and exciter, and to the floors above. The former pair of machines are employed for lighting the building, heating the carbon filaments during the process of exhaustion, and for general experimental purposes.

The ground-floor is devoted to a store room and the glass-

blowing room, in which twelve mechanical glass-blowers are arranged, being driven by a power shafting which also works a series of air compressors for supplying air to the blow-pipe flames and the necessary high pressure air for blowing out the bulbs.

The machines in this room are manipulated by boys ranging from 14 to 16 years of age, who are employed in the various processes of blowing bulbs, sealing in the carbon filaments, &c. The mechanical glass-blower, as may be seen from the drawing and as we have already explained before, is very similar in construction to a lathe, but is supplied with two headstocks fitted with hollow mandrels and chucks which hold the glass tube to be shaped. The mandrels revolve synchronously, the one headstock being a fixture and the other capable of traversing the bed by means of a hand-wheel rack and pinicon. The machine is also supplied with a blow-pipe attached to sliding saddle, and suitable valves actuated by a bridle for the admission of air to the mandrels.

The operation of blowing the bulbs is as follows:—The boy takes a piece of glass tube 9 in. long and ¾ in. diameter, and, having gripped each end in the chucks provided on the mandrels, starts the machine and brings the flame of the blow-pipe to bear upon the middle of the length of tube, which, being softened, is drawn out into a small tube, thus forming two "pump-stems," the flame is then caused to play on the original tube between its extreme end and the drawn-out "pump-stem" which, being softened is blown out to the shape required. This operation is repeated on the other end of the tube, thereby making two bulbs from the single tube. The admission of this air, the direction and force of the blow-pipe, the approach and recession of the mandrels, so as to lengthen or shorten the bulb, are all readily controlled by the boy operator, who is able to blow on an average from 250 to 300 bulbs per diem. By a succession of somewhat similar processes the whole of the glass-work in the incandescent lamp is finished. A boy blows the bulb, a boy fixes the two platinum electrodes together by a bead of glass, and a boy inserts the mounted filament into the end of a finished bulb, thus preparing the lamp for the pumping and sealing off, which is done upstairs.

The preparation of the filaments is carried on in an upper room. Almost any kind of tough vegetable fibre will serve, because the inventors have a special process for densifying it and giving it a metallic lustre. The fibre actually employed appears to be a species of grass, not unlike that coarse, wiry grass which often grows by the seaside. A length of grass is bent by a boy round a metal mould into a special helical form. These fibres on their moulds are then gently heated, thereby fixing their shape. They are then heated in a fire-clay furnace, which carbonises them, and they are then sent into the mounting-room, where they are fixed on the platinum electrodes which have been prepared for them. The mounting is a secret process, but it mainly consists in sticking the filament ends into the hollows of small spirals turned on the upper ends of platinum electrodes, and cementing them there with a special cement. The filaments thus mounted are then "flashed" in a special liquid, which decomposes and deposits in their pores, forming a dense elastic carbon having a bright metallic lustre. The proper resistance is first estimated by the light given out by other lamps in circuit with the filaments, and checked by a "Wheatstone bridge." Thus finished off, they are taken down to the glass-blowing room, where they are inserted into the bulbs and sealed there by the machines we have described. The lamp is then taken to the pumping-room, where there are a series of mechanical mercury pumps, each capable of exhausting 12 lamps at a time. For this work only two men are employed, for by setting the lamps in groups at different stages of exhaustion one man can attend to the exhaustion of a large number of lamps, sealing off the completed lamps and supplying fresh ones as the pump continues to act for itself.

A clear view of the pumps and the exhausting frames is given in the drawings. The mercury reservoirs are raised and lowered automatically on suspended shelves by straps from the power shafting, and the velocity of movement is adjusted by means of a half-moon pulley, which allows the reservoir to move slowly at the beginning and end of its up and down range where the pumping is better done slowly.

The lamps are attached to spiral springs, which pull them upwards as they are sealed off, and thus facilitate the act of sealing. The mercury pump is an improvement of Messrs. Wright & Mackie's, on the ordinary pump, and obviates the tedious necessity of taking out a stopper to let the air escape. The valves of the pump are in fact automatic also, and thus the entire arrangement is self-acting. The degree of exhaustion can be estimated by the height of the mercury column, and is from one-millionth to one and a half-millionth of an atmosphere. The whole of the work of the factory is regulated by a piece-work system, and it is stated that by the means described, the manufacture of incandescent lamps is very greatly economised, and their rate of production increased.

Although the present application of Messrs. Wright & Mackie's glass-blower has been to the manufacture of incandescent lamps, yet it is capable of very universal application, to chemical, philosophical, medical, and domestic glass-ware, and we have no doubt will be largely employed. In conclusion, we have every reason to endorse most fully our former favourable opinion on this apparatus, and we have no hesitation in saying that we have not yet seen anything in connection with incandescent electric lighting of such an eminently practical character, or so calculated to further the progress of this method of illumination, as Messrs. Wright & Mackie's mechanical glass-blower.

These young electricians have struck out a decided path for themselves, and we shall look forward with interest to the further development of their comprehensive and practical ideas.

ELECTRICITY AS A MOTIVE POWER.

By Prof. GEORGE FORBES.*

(*Continued from page* 413.)

OF course, it is only after long experience that we shall know what is the maximum power which we can send along a wire, and what limits must be put to the electromotive force which we use. M. Marcel Deprez has spent much time and labour on making practical tests of this nature. One of these formed a chief attraction at the Munich Exhibition last year, where he used an iron telegraph wire 4 mm. diameter (or a sixth of an inch), and transmitted ½ horse-power to a distance of 35½ miles. He has since been carrying on experiments of the same kind at Paris. The results have lately been published, and I shall return to them.

One of the chief things which I proposed to myself, when I was asked to read a paper here, was to give some account of the experiments which I saw at Munich. I was very much struck indeed with the transport of energy by Mr. Schuckert, of Nürnberg, not that there was any new principle involved, but I had never before seen so much as five or six horse-power conveyed by a thin wire so far as three and a-half miles. The power was derived from a turbine, at Hirschau, beyond the English gardens. These turbines are employed on a locomotive factory, no steam being used in any of the shops. They have thus 260 horse-power at their disposal. The machine at Hirschau was of a larger size than the motor in the exhibition. This is a point on which Mr. Schuckert has made careful experiments. This machine, which was driven by the turbine, worked a number of agricultural machines during the day, and served to light thirteen Pilsen lamps at night, both being in the exhibition building. The turbine being a very large one, and revolving slowly, transmitted its power to the dynamo by belts. A turbine is a very convenient motor for a dynamo, for it happens that, when we are using a dynamo requiring the whole power of the turbine, the proper speed for each is nearly the same, so that the dynamo may be attached directly to the shaft of the turbine, which is, of course, a very great convenience and a saving of power. In my experiments, in conjunction with Dr. Young, on the velocity of light, at Wemyss Bay, I made use of such an arrangement for producing the electric light. A small Siemens machine was attached directly to a Thomson's vortex turbine with horizontal shaft. The water was led from a distance of nearly a mile. The convenience of being able to start the electric light by merely turning a handle was very great indeed, and I can recommend this arrangement to any one who has water-power at his disposal.

But to return to the Hirschau installation. A pair of No. 7 copper wires conveyed the current, one-eighth of the E. M. F. being wasted in heating the wire. This installation, taken as a whole, was much to be admired. I do not say that there was anything new or much information to be gained from it, but it showed to every one visiting the exhibition a good working practical installation. Mr. Schuckert has been good enough to give me the results he has obtained from two experiments with different sets of machines. All the four machines with which these experiments were made are constructed for generating a current of eight ampères. In one experiment the generator was constructed for fifty-five incandescent lamps, with a motor constructed for thirty-three lamps (the lamps being in compound parallel). In the other he used as generator a machine for about 150 lamps, with a motor made for eighty-eight lamps. The particulars of the machines are given in the following table, from

* Read before the Society of Arts, Wednesday, May 2nd.

which we see that in each case 36 per cent. of the energy put into the generator was reproduced as work done by the motor:—

	First Experiment.	Second Experiment.
Type of generator	TL 3	TL 5
Type of motor	TL 2	TL 4
Difference of potential—		
(1) At terminals of generator	300	700 volts.
(2) ,, ,, motor	260	600
Resistance of leads	6 ohms.	12 ohms.
HP. spent on generator	4·4	12·8
HP. given by motor	1·6	4·7
Efficiency (per cent.)	36	36

I give you these figures, not because they show any wonderful performance, but because it is desirable to have as many facts as possible when any new idea is being developed.

You see that in these experiments the aim has not been so much to get a high efficiency as to get a high amount of power developed. This is what ought always to be done, while the machines form the chief item of cost.

Let us now speak of the experiments of M. Marcel Deprez. In 1881, M. Deprez published the theory of transmission of energy to a distance, by means of a thin wire. It is a theoretical fact that, if you get a certain return by using a given generator and a given receiver, and with a certain length of wire between the two, you can double the distance with the same results as to power, using the same thickness of wire, if you construct a new generator and a new receiver wound with smaller wire, so as to have double the resistance of wire wound, the other dimensions of the machine being unchanged. This had been known before, and the theory had been fully worked out by Frölich and others. But Deprez had the credit of working out numerical examples, and of afterwards putting the theory to the test of experiment. In his first paper, he started with some experiments made at Chatham, in which two Gramme machines were used, one as generator, the other as receiver, when, through a line-resistance equal to that of either machine, a return of 50 per cent. was obtained. He then showed that theoretically a similar pair of machines could be constructed so as to transmit 50 per cent. of the energy to a distance of 100 kilometres an ordinary telegraph wire being used 4 mm. thick, giving a resistance of 9 ohms to the kilometre. He also stated that 12 horse-power being used by the generator, 6 horse-power would be delivered by the receiver. I do not consider that the theory in this paper was quite clear, but the main point was proved.

After the publication of this paper, the Munich Exhibition was a thing of the immediate future, and M. Deprez was invited to make his experiment with a distance of sixty kilometres. The resistance of a telegraph wire of this length, using the earth for the return, was 475 ohms. Consequently, two machines were made of the normal type, like an "A" Gramme, each of 453 ohms resistance. These machines developed very high electromotive forces (about 2,000 volts), and when they were installed, it was naturally discovered to be impossible to use the earth as a return. Consequently, another wire was used, increasing the resistance to 950 ohms. This militated against the complete success of the experiment, and I think it is unfortunate that, in their desire to assert the success of the experiments, the friends of M. Deprez withheld this fact from the public, and so led many people to believe that the theory was inexact. As a matter of fact, owing to the great resistance of the line, 60 per cent. of the total electric effect was used up in heating the circuit, instead of 40 per cent., as had been calculated. In order, then, to get a satisfactory return, it was necessary to allow the receiver to do very little work. Thus, in the trial made by the committee of experiments before the machine broke down, only 0·433 of a horse-power was utilised at Munich, and there was a return of 39 per cent. of the power put into the machine at the distant station of Miesbach.

These experiments were of a very high degree of interest, and M. Deprez deserves the thanks of scientific men for the zeal he showed in carrying them out. Let us see, now, whether an economy would thus be introduced by burning coal at the pit mouth, and transmitting power, as in the Miesbach experiment. Allowing 3 lbs. of coal per horse-power per hour, if we work twenty-four hours a day for 300 days in the year, we have almost exactly 10 tons of coal per horse-power per annum. Suppose the coal costs 5s. a ton at the pit mouth, and ½d. per ton for transport over the kilometre, it follows that the cost of furnishing 0·433 of a horse-power at Munich by transport of coal would be the cost of 4·33 tons of coal, and their transport over 60 kilometres, amounting to £1 11s. 6d. The cost of coals to work the machine at Miesbach, with a duty or efficiency of 39 per cent., would be £2 19s. Let us assume the machines to cost £100 together, then, neglecting the cost of the telegraph wire, and allowing 15 per cent. for interest and depreciation of the machines, neglecting also the extra cost of the larger steam-engine required at Miesbach, we have an annual expense of £17 19s. for the power delivered electrically at Munich, against £1 11s. 6d. for the same power delivered by the transport of coal. Even if the machines cost nothing there would be a loss. It is folly to use machines costing so much only to produce ½-horse power.

I have no doubt that M. Deprez could have got more than a ½ horse-power at Munich, but had he attempted this it would have been at the cost of efficiency. It cannot be too constantly borne in mind that in electro-mechanics you can increase your efficiency almost up to unity, but at a sacrifice to the total amount of work transmitted. But it must also be constantly remembered that you increase your total work up to a certain maximum, but at the cost of efficiency. The maximum efficiency is obtained when the load is so great that the motor is only just able to turn round. The efficiency is greatest when the load is so light that the motor turns nearly as quickly as the generator. I repeat that an erroneous idea has been promulgated that we ought always to run motors at a speed approaching to this condition of maximum efficiency. But if this be done, the return of work is insufficient to pay for interest and depreciation on the plant required.

The very important experiment of M. Deprez at Munich, is able to give us much information for future use. Among other facts, we learn that, with machines of the type described by him, 2,000 volts is too high an electromotive force to employ. The reason is that it is impossible to prevent the contact of the brushes from being sometimes accidentally broken. In such a case it was found that the electromotive force developed by the extra current is sufficient to ruin the insulation.

Another matter deserving of attention is the relative size of the generator and motor. M. Deprez employed two machines of equal size. This slightly simplifies the theory, but it is certainly not the most advantageous arrangement, and we are much in want of accurate measurements on this head.

From what has been said, it is clear that the Deprez, experiment at Munich was, commercially, a failure. You might, at first sight, think that if a thoroughly scientific experiment like this was a commercial failure there are no cases in which it would be a commercial success. This is by no means the case. Since the time of the Munich Exhibition M. Deprez has been occupied with experiments of a far more practical nature, with a line of 160 ohms resistance. In the latest experiments, where the effects of friction were deducted, a return of 47½ per cent. was obtained, and 4·4 horse-power of work was actually given off by the motor. Judging from the Hirschau experiment, I should say that if a fall of water be used as the motive power we can install a turbine and dynamos which shall transmit six horse-power through a resistance of 12 ohms, at a cost of £200, neglecting the unknown cost of the conductor. If this power were used in a place where coal costs 20s. per ton, the cost of fuel for six horse-power would be about £60 per annum. The interest and depreciation on the boiler and steam-engine would be about £30 per annum, making in all £90 per annum, exclusive of wages. Electrically transmitted, the interest on plant, at 15 per cent., would be £30 per annum, exclusive of wages. This difference of £60 per annum, after deducting from it the interest and depreciation of the conductor, is so enormous that it is easy to see what a large saving would be effected in any installation where there is a large consumption of power. There are many factories where it is essential to use a high-priced coal, but if the power could be conveyed electrically from a distance of a few miles an immense saving would be effected by employing a cheaper kind of coal. When water-power is used it often happens that we can convey the cables along the bed of the river. This preserves the insulation and keeps the conductor cool, so preventing the usual increase of resistance by heating.

In some towns, and notably in Sheffield, the whole of the water supplying the town comes from reservoirs at a very great height. The very large quantity of energy of this water is at present absolutely wasted; and although coals are not dear in Sheffield, and manufacturers are permitted to burn the most smoky kinds of coal in the centre of the town, yet the employment of this waste water-power would add very considerably to the commercial prosperity of the town, and the water would be injured in quality no more by passing through turbines than by passing through the present pipes. If this power were distributed electrically the benefit to the community would be great indeed.

(To be continued.)

NOTES.

To our Readers.—We are, owing to pressure on our space, compelled to hold over several most interesting articles and numerous letters.

Electric Lighting.—The St. George's Vestry (Hanover-square) agreed, at their meeting last week, to support the applications of the Swan Electric Company and the Metropolitan Brush Company now before the Board of Trade to supply the electric light to the parish.

Col. Majendie, Board of Trade Commissioner, a few days ago held an inquiry into the demands of the Croydon Local Board of Health as to the experimental lighting of a portion of Croydon town by the South-Eastern Branch Concession of the Brush Company. Mr. West attended, as solicitor to the Local Board, with Messrs. Mitchiner and Grundy, as members, and Mr. Walker, as engineer; and Mr. Webb, on behalf of the company, with Mr. George Offer, as the secretary of the South-Eastern Branch. After a very long contention, there was a tacit understanding, subject to the Board of Trade and the local authority, that the company should light up the area it proposed within eighteen months, and the extended area defined by the Local Board in a further period of twelve months, and that the company should deposit £1,000, and give such guarantees for the remainder as would be satisfactory to the Board of Trade.

At a meeting of the Fulham Board of Works last week, the clerk said he had received notice from the Board of Trade that the Brush Company was going on with its

order contrary to expectation. Acton and Ealing were represented at an inquiry on the subject on the previous Saturday. At that inquiry Fulham was struck out of the Brush Company's order. The West Middlesex Electric Lighting Company, which had obtained a license for the lighting of the Fulham district area, was proceeding with the work.

At a recent meeting of the Croydon Local Board, Mr. Mitchiner quoted some figures which he said fully bore out his statement that "the science of electric lighting looked more like a commercial fact than it had previously done." An electric lighting company had, he said, entered into a contract with the Corporation of Nottingham, to light 60,000 lamps for eight hours daily for a year at half the cost of gas. As the happy dwellers at Nottingham only paid 2s. 6d. per 1,000 feet for their gas, the comparison was most remarkable. Mr. Mitchiner, however, does not appear to have been rightly informed; for a writer on the subject in the correspondence column of *Engineering* of last week, says that it would appear from the specification that the tender of the Telegraph Construction and Maintenance Company was likely to be adopted by the Nottingham Corporation, or had at least been prepared at their request. Knowing Nottingham well and knowing something of the views of its Town Council on the lighting of the town, he was greatly surprised by this. Upon inquiry at Nottingham after the facts of the case, his suspicions as to the genuineness of this business were confirmed, and he had very good grounds for saying that so far from this tender being accepted, it would not even be brought before the Council or discussed in any way, and probably no notice whatever would be taken of it.

The Lumley Electric Light Company has just put a Lumley machine and sixty Woodhouse & Rawson incandescent lamps into Messrs. Barrett & Co.'s mineral water works, Vauxhall. Messrs. Woodhouse & Rawson were the contractors for carrying out the work.

According to a correspondent of the *Engineer* in the matter of electric lighting, the Birmingham Corporation has come to an arrangement with various companies on the basis of the model order issued by the Board of Trade. This order does not, however, satisfy the authorities of Wolverhampton, Walsall, Dudley, West Bromwich, and some other places, and a Local Government Board inquiry has just been held in Birmingham to hear objections. The result is that the local authorities mentioned have gained important concessions, which at present Birmingham is without. The Lords have granted that other companies may apply for powers to step in if the original company will not provide the electricity at a reasonable price, and of proper quality, and in continuous supply. Again the Board has consented to transfer from the ratepayers to the company the cost of stations, appliances, and special officers for the testing of electricity. A third concession was that the costs of the local authorities, legal and otherwise, touching the Parliamentary opposition, should be borne by the company.

Five of Messrs. Morewood & Co.'s Sheet Iron Mills, at Soho, are now lighted by eight arc and twenty incandescent lamps of the Gülcher Company. This system has been adopted, it is said, on account of its low tension, and because of the safety which results from the fact that the conductors can be grasped with impunity.

Having completed the lighting of the Bourke-street Arcade, Melbourne, and extended its operations to North Melbourne and other suburbs of the Victoria metropolis, the Australian Electric Light Company is now busily engaged with several other works.

An exceedingly interesting and instructive exhibition was recently held in the small Concert Hall, Dublin. Among the various exhibits were the Maxim incandescent and the Weston arc electric lamps, displayed by Messrs. G. Prescott & Co., who afforded the best test of their systems of illumination by using them for lighting the hall. The effect produced was decidedly fine, and the illumination exceedingly brilliant, being in the latter case very steady, and unaccompanied by unpleasantness to the eyes. A sewing machine, worked by electricity, was also shown, and various other wonderful triumphs of man's ingenuity over "lightning enslaved" were exhibited and explained. Messrs. G. Prescott & Co. have fitted up the Maxim lamps at the Masonic Female Orphan School, and shown Masonic devices lighted by the incandescent lamps.

Experiments are being made to test the suitability of the electric light for illuminating the grand rooms of the Reform Club. An Elphinstone and Vincent shunt-wound dynamo is used to drive twenty Swan lamps lighting one bay of the grand library, and fifteen Woodhouse and Rawson lamps in ground glass bulbs hung to light one end of the coffee room. The lamps are driven to their full power, and bring out to perfection the beautiful designs of the carved and nicely decorated ceilings and pilasters of these magnificent rooms. The usual illumination is by oil and paraffin lamps, so that the contrast is very great. Moreover, candles are dispensed with, and members can see to read or eat, sit where they may. The dynamo is capable of driving 400 Swan lamps, but only forty are in actual use, since the engineering arrangements are very scanty. The motive power is supplied by an Easton and Amos table engine of about 6-horse power, which dates nearly from the foundation of the Club. For reasons we need not enter into, this engine had to be made the best of or the experiments given up. It was therefore resolved that a secondary battery should be employed, either in aid of or in substitution for the dynamo; so that wavering, unsteady lamps might not prematurely condemn the system. The battery, however, has not even been brought into the building; the Elphinstone and Vincent dynamo proved itself capable of setting straight and controlling any little irregularities on the part of the old engine. The lamps night after night burn with great brilliancy, and without the slightest flicker. A gold and crystal electrolier by Defries, whose design harmonizes better with the gorgeous character of the surroundings than the simple ring at first used, is now being suspended in the Library, and will be supplied with mixed ground and plain glass bulbs. Few people passing along Pall Mall imagine that steam engines, boilers, pumping apparatus for a well 345 feet deep, and an electric light installation, are busily at work in the cellars beneath the pavement.

The following is a description of a most successful installation of six Pilsen dynamos and 50 Pilsen arc lamps, which has recently been completed at Messrs. Lewis's, Liverpool. We believe we are right in saying that this is the largest installation of arc lights that has yet been made in one establishment. The work was intrusted to Messrs. Woodhouse and Rawson, of London, and has given every satisfaction. We may mention that Messrs. Lewis are not by any means new to electric lighting, having for the last two or three years made various experiments with different systems, and their present house in Manchester has been for the last year or two chiefly lit by Siemens arc lamps. The building consists of two portions, the old place of business and a new one, which was opened shortly before Christmas. The intention was to light up the whole of the building with arc lamps, but as some of the floors are not occupied, 15 lights have been temporarily put up in the old building. Here the lights are on the ground floor; in the new building they are distributed over four floors, and over the pavement on the outside. In the basement, which formerly was unbearable when gas was used, four lights have been placed. On the ground floor there are 17, including a large 4,000 c.p. lamp in the doorway. On the first floor six, and at the top of the building, in what is called the Lantern, nine. The effect of these latter, the light from which comes through stained glass slides, is very fine, and can be seen from a considerable distance. Half the sub-basement is at present set apart for engine and machine room. The engine and boiler were supplied by Messrs. Marshall, Sons & Co. The boiler is of the locomotive type, in which steam can be raised in a very short time to a working pressure of 60 lbs. The engine is 35 H. P. nominal, high pressure horizontal, 18-in. cylinder, 3-ft. stroke, with automatic expansion valve worked from the governor. It runs at 70 revolutions per minute, and is capable of running about 100 2,000 c.p. lamps. The power is communicated from a 10-ft. fly wheel to a 4-in. steel countershaft, and thence to the dynamos. The dynamos and lamps were made by the Pilsen, Joel, and General Electric Light Company; the machines, like those of the Schuckert class, being of the ring armature type. The dynamos work respectively one 4,000 c.p. lamp, 12, 14,

12, 7, and 5, 2,000 c.p. lights; and they are wound in series giving an E.M.F. of about 42 volts per lamp, with a current of about 8 ampères. The cables used are seven strands of copper No. 16, B.W.G., heavily insulated. Above each machine is a German silver resistance board, of about four ohms, by means of which the resistance of the external circuit is regulated when required. The leads and returns are taken from each machine to a switch board for the purpose of facilitating change of circuits, as it is often required to run different groups of lamps independent of the circuits upon which they may happen to be. This grouping is materially helped by means of switches arranged in convenient parts of the building. From the switch board the cables pass into an airshaft, which, running to the top of the building, is used for ventilating the different rooms by means of channels between the ceiling and floor. These channels, which are covered by moveable boards screwed down with iron bearers and lugs let into the rafters, carry the cables after they leave the airshaft. This arrangement avoids the appearance of leads on walls and ceilings, a ready access being had to the wires, which are brought down to the lamps through holes in ornamental work in the centre of which the lamps are hung. The cables for the old building pass right up to the top of the ventilating shaft, and are then carried overhead from roof to roof and down to the ground floor, to a switch which is so arranged that eight lights may be run off the seven-lighter during the early part of the afternoon, until the other four are required, when the whole are switched on to the 12-lighter C2, from the switch board in the engine room.

The steam ship *Ipswich* launched from Earle's Engineering and Shipbuilding Company's yard at Hull, on Monday, for the Great Eastern Railway Company's steam service, is to be electrically lighted throughout.

The illuminations at Moscow on Tuesday evening, were less brilliant than had been expected; enough, however, was done to render the spectacle a charming one, and to delight the vast crowd which gathered in the street. At the British Embassy in Ivorskoi a very pretty effect was produced by the tracing out of windows, balconies, and cornices with Swan incandescent lights, some in ground glass globes, some clear.

On Tuesday evening last, a private trial of a new Edison-dynamo for search light purposes, designed by Dr. Hopkinson, F.R.S., took place at the well-known engineering establishment of Mr. Peter Brotherhood, Belvedere Road, Westminster. The lamp used with this machine burned carbons of 1 inch diameter during the tests, although these are not really so large as are intended to be employed. The electromotive force of the machine is about 50 volts, and the current given was stated to be about 125 to 130 ampères. The light was exceedingly powerful, and general satisfaction appeared to result from the experiments. We are not able to give any particulars of Dr. Hopkinson's modifications of the Edison machines owing to the usual plea of "non-completion of foreign patents." We may say, however, that the type of machine usually employed for 60 incandescent lamps is now made to actuate 200.

At a meeting of the Electric Lighting Committee of the Leeds Corporation held on Monday, plans and particulars prepared for the information of persons desirous of tendering for lighting the Victoria Hall, portions of the new Municipal Buildings, Victoria Square, and Calverley Street, by electricity were approved by the committee, and ordered to be sent to certain companies and persons who undertake the carrying out of such work. It is proposed that Victoria Hall shall be lighted with 500, 20 candle-power lamps, which are to be distributed so as to conduce to the most brilliant illumination of the hall, and to be in harmony with its architecture and ornamentation. In connection with the Free Public Library, the general reading-room will be lighted with 51 incandescent lamps; the lending library with 70; the reference library (lower room) with 60; and the reference library (upper room) with 80. Each arc lamp will be of about 1,000 candle power. One of these is to be fixed in the vestibule of the Town Hall, one in the vestibule of the Municipal buildings, one in Calverley Street, two in the general pay office, two in the clerk's office and four will be used for the lighting of Victoria Square. It is intended that the Crompton-Burgin dynamo machines shall be first used. The Corporation make no stipulation as to what description of arc lamp shall be included in the tenders. All the plans have been drawn to scale, and indications have been given on them of the points at which the committee consider each lamp or pendant might be fixed. The committee, however, state in their instructions that persons tendering are at liberty to recommend any improvement either in the position or in the number of lamps, and to make any suggestions with reference to the general scheme of lighting. Tenders for the supply of the electric light are invited for periods of one and two years respectively, but they must be sent in in alternative form, showing the cost at which the work can be carried out in either case. The contractors are also asked at what sums the Corporation may purchase the whole of the plant furnished by them at the end of the first or the second year. The committee will enforce as a condition that in the event of the electric lighting not being carried out satisfactorily, the contract shall be determined between the parties. The tenders will have to be forwarded to the Town Clerk not later than June 21st, and the whole of the plant must be ready for lighting purposes not later than two months from the date of the acceptance of the tender.

Incandescence Electric Lamps.—Mr. R. E. Crompton, writing to our contemporary *The Engineer* last week regarding an article which had appeared on electric lighting, says:—"I cannot follow your argument as to the increase of efficiency to be anticipated from increasing the resistance, or electromotive force required by the lamps. As far as I am aware there is no gain from this cause. In fact I believe that, on the contrary, the short filament lamps can be worked safely at higher temperatures than the improved lamps with long, hair-like filaments, and should, therefore, be more efficient. At any rate, so far as the Swan Company's lamps are concerned, their most recent lamps, requiring current of 160 volts electromotive force, having filaments of 360 ohms resistance hot, and taking ·44 ampères of current, are intended to be worked at the same efficiency—viz., 210 candles per horse-power—as the 40-volt lamp, having a resistance of 30 ohms hot, and requiring 1·33 ampères for 15·2 candles. The main object we wish to attain by the use of lamps requiring high electromotive force is the reduction of the weight of copper used in the conducting wires. Thus the 160-volt lamp above mentioned only requires one-sixteenth the weight of copper in the main that the 40-volt lamp does. The manufacture of lamps of such high resistance as 360 ohms hot is a very difficult matter, as will be readily understood when we remember that the filament of the 160-volt lamp has only one-fourth the sectional area, whilst it requires to be fully three times the length of that of the 40-volt lamp. The formation, carbonising, and fixing-on of the metallic contacts to such delicate, hair-like filaments of carbon is a triumph of delicate manipulation. If accumulators can be successfully applied as reservoirs of electrical energy in the houses of the users of electricity, lamps requiring currents of low electromotive force from 10 to 40 volts will be largely used; but for the present, so long as we are compelled for the sake of simplicity of arrangement to put all the lamps of an installation on one parallel, the demand will be for lamps requiring currents of as high electromotive force as possible, *i.e.*, within the Board of Trade limits of 200 volts. This demand the Swan Company have already met by supplying lamps of 80, 100, 120, and latterly even of 160 volts, all being of 20-candle power. I have confined my remarks to the incandescence lamps manufactured by the Swan Company, but it is but fair to say that I believe that the Edison Company also is manufacturing lamps of high electromotive force, but I am not in possession of sufficiently accurate figures to compare the two lamps together. Dr. Hopkinson, in his lecture at the Institution of Civil Engineers a few weeks back, stated that the 110-volt Edison lamp takes ·75 ampères, and therefore requires 83 volt-ampères to give 16 candles. This is equal to an efficiency of 144 candles per horse-power, and it is therefore inferior to that of the Swan lamp nearly as 7 is to 10. The cause of this inferiority I believe to lie in the fact that owing to some peculiarity of forming the filament and connections, the Swan lamp can be safely worked at a higher temperature than that of the Edison, and this plainly shows itself in the difference in the

colour of the two lights—the filament of the Swan lamp being as a rule worked at a far whiter degree of incandescence than that of its rival."

The Rival Telephone Companies.—Theodore Torry, manager of the Globe Telephone Company, and William Goodfellow and James Molyneux, two men working under him, again appeared before Mr. Alderman Stone, at the Guildhall Police Court, on Friday of last week, to answer the accusation of the United Telephone Company, of wilfully and maliciously injuring their wires. Several witnesses were examined as to the responsibility of the defendants for tying up the wires, but no result was arrived at, and the case was again adjourned. In the Chancery Division of the High Court of Justice on Tuesday, Mr. Cozens Hardy, Q.C., and Mr. Moulton, moved on behalf of the United Telephone Company for an injunction to restrain the London and Globe Telephone and Maintenance Company, their servants, agents, and workmen, from interfering with the telegraph or telephone wires of the plaintiffs, or the supports thereof, or any instrument or apparatus connected therewith, and they asked for an order directing the defendants forthwith to take down or remove any posts or wires or other erections placed or erected by them so as to interfere with any such wires, supports, or apparatus. The defendants' company, it was said, was formed in August of last year for the purpose of carrying on a business similar to that of the plaintiffs, and in erecting their poles and passing along their wires they had seriously interfered with the wires of the plaintiffs. In some cases they had allowed their wires, through which no messages were at present passed, to rest upon those of the plaintiffs. In other cases they had interfered by means of their poles, and in many instances the defendants' wires were placed so close to those of the plaintiffs' that a slight wind, or even change of temperature, caused the wires to join together, and to pass the electric current through the wrong wires; but the worst instances of interference were where the defendants had actually coupled together the plaintiffs' wires by means of a band, 17 in one place and 19 in another. The effect of this interference with the plaintiffs' wires was sometimes to cause the bells of subscribers to be rung at the wrong time and place, and sometimes all the bells were set ringing at once, to the great annoyance and injury of the subscribers generally. Mr. Hemming, Q.C., and Mr. Beale, who appeared for the defendants, asked for time to answer the plaintiffs' affidavits, copies of which had only been furnished to them yesterday. They were instructed to say that an answer could be given to all the allegations made by the plaintiffs, but this would necessitate the examination and cross-examination of witnesses, and it would be impossible to prepare the defence in less than a fortnight or three weeks.

Mr. Cozens Hardy, Q.C., submitted that if the case was ordered to stand over for so long a time the defendants ought to be put upon an undertaking either to alter their poles and wires, so as to avoid any interference with the plaintiffs' wires, or they should allow the plaintiffs to do the work themselves, and it was pointed out that there would be no difficulty in doing this at once. If this was not done the injury to the plaintiffs' business might be continued for three weeks or more until the case could be brought on for hearing. The defendants not acceding to the plaintiffs' proposal, Mr. Justice Pearson said, under the circumstances, he must treat this as an *ex parte* application, and he should grant an injunction in the terms of the motion to restrain the defendants from interfering with or continuing to interfere with the telegraph or telephone wires of the plaintiffs.

Metallic Microphones.—Those of our readers taking an interest in the discussion going on in our correspondence columns on the above subject may also like to know that we have had brought before our notice a metallic microphone experimented with in October, 1881, and constructed as follows:—Two pieces of finely corrugated foil were taken from a package of tobacco, and the corrugations made more decided by having pin holes made in the foil. These formed the electrodes, whilst a third piece of foil treated in the same manner acts as a bridge across the two. The gentleman who devised this microphone, which we have now before us, assures us that it acted well, and we see no reason to doubt it. How long such appliances would last in actual practice, however, is another matter entirely.

The Proposed Electric Railway Under the Thames.—The withdrawal of the Charing Cross and Waterloo Electric Railway Bill in the present session will not, the *Standard* says, interfere with the accomplishment of the project for constructing an electric railway under the Thames at Charing Cross. The Act authorising that undertaking was obtained last year, and arrangements have been made for carrying out the enterprise. It is understood that the promoters of the Bill, which has just been abandoned, thought it prudent to avoid a contest in the present session, hoping to have a more favourable opportunity a year hence, when the practicability of their scheme would be better understood by the Corporation and by Parliament.

Personal.—Mr. Hugo Pischon has been appointed by the German Edison Company of Berlin assistant managing director. Mr. Pischon, after introducing the Pintsch system of lighting railway carriages by gas into England, occupied for several years the post of general manager to the Pintsch Patent Lighting Company.

Transmission of Power.—The second number of "Annals of the Ouro Preto School of Mines—Annals da Escola de Mina de Ouro Preto"—contains a paper on the transmission of motive power to a distance by electricity, from the pen of Professor Thiré.

Underground Signalling in Mines.—The necessity for a good system of signals in mines is, says the *Mining Journal*, now engaging attention. The old method of signalling with knocker line or bells is considered inapplicable for great depths or extensive works. The telephone has been tried but given up, and signalling by electricity is being reconsidered, and although at first the arrangements were found defective in detail one eminent mining engineer now states that he has found no difficulty in arranging signals for an indefinite number of roads, by having a pointer attached to them or a pendulum to show which bell was sounded. In some instances it has been found advantageous to have one battery and two separate wires where there has been a number of stations, and one bell has been found sufficient for any number of off-shoots. It has been suggested that the wires might be injured by a fall of stone or mineral, but the wires are generally placed in the roads, so that the stone, &c., would be hardly likely to touch them, and therefore there is no danger to be apprehended in that direction; but even were the wire damaged it could be easily repaired. The Sax system has also been adopted in the North of England, and a similar arrangement has long been in use at the Mickley mines in Northumberland. In the early introduction of electric signals, such as those noticed, difficulties were met with, but these have now disappeared, and electric signal bells are admitted to be the best and cheapest that can be adopted for undergound working.

Secondary Batteries.—At a recent meeting of the Society of Chemical Industry, held at Burlington House, Mr. C. T. Kingzett, F.I.C., F.C.S., read a paper on "Secondary Batteries," in which he pointed out that he thought the construction of efficient secondary batteries was rather the work of chemists than electricians or engineers. After describing the more important forms of accumulators, already publicly known, and their shortcomings, he gave an account of his own invention. Where others use lead for the construction of the supports of secondary batteries, Mr. Kingzett has found a means of employing iron, which is as much cheaper as it is lighter. The form of his supports, or plates, is also of an improved pattern, and the loss of energy by "local action," which is so great in most other accumulators, is avoided in the batteries patented by Mr. Kingzett.

Telegraph Extension.—A short while ago the construction of a telegraph line between Shanghai and Tientsin was authorised. This line is now to be extended to Pekin. Telegrams are to be forwarded in French or English. Two mandarins have been appointed to keep a rigid surveillance over all telegrams, so that they may not in any way compromise the security of the State.

The Reduced Telegram Rate.—The Press Association learns that with a view to overtaking the largely increased telegraphic work that is expected to follow the adoption of a sixpenny rate, four new wires are being erected on the west coast route to Glasgow.

An Electrical Railway Company.—At Albany, New York, on Monday, May 7th, papers were filed incorporating the Electrical Railway Company of the United States. According to the *Electrical World*, Mr. Stephen D. Field, one of the patentees and electrician to the company, states that the system is based on a combination of patents owned by Mr. Edison and himself. The company is to carry on business in both the United States and Canada. It possesses and controls all the apparatus formerly owned by Mr. Edison and Mr. Field, including Mr. Edison's electric railway at Menlo Park, three miles in length, which has been running since last summer. Mr. Field added that the company would be ready for business some time during the coming fall. There was no probability of the enterprise falling through. It is understood that Mr. Edison will be the consulting electrician for the new company, but neither a director nor an officer. The first practical work to be undertaken by the new company will, it is said, be to place an electric engine in operation on the elevated railway, the arrangements to do this having already been begun.

NEW COMPANIES REGISTERED.

Electropathic Association (Limited).—Capital £15,000, in £5 shares. Registered office, 21, Holborn Viaduct. Object: To purchase from the Pall Mall Electric Association (Limited) a licence to manufacture and sell in the United States of America their patent and registered electropathic belts, galvanic generators, and other appliances, and also for the use of their trade marks. The purchase consideration is 1,000 fully paid shares and one-third of any further issue. Signatories (with 1 share each): G. J. Baker (electrician), 21, Holborn Viaduct; L. Graff, 6, Fenchurch Street Buildings; J. A. Winter, Bridgwater; H. Barrett, Dulwich; G. J. Elers, 91, Holland Road, S.W.; F. R. Nevill and W. T. Nevill, Llanelly. Directing qualification, shares to the value of £500; remuneration, £5 per cent. on the net profits. Registered 16th inst. by C. Doubble, 14, Sergeants' Inn, Fleet Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Electrical Appliances Syndicate (Limited).—The first return of this company, made up to the 21st of November, 1882, was filed on the 12th inst. The nominal capital is £5,000 in £10 shares. Nine shares have been taken up, and the full amount has been called thereon. The calls received amount to £1,940, which includes £1,850 for shares for which share warrants comprising one share each are outstanding. Registered office, 8, Union Court, Old Broad Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The West India and Panama Telegraph Company (Limited).

On Wednesday afternoon last, the 12th ordinary general meeting of this company was held at the Cannon Street Hotel, Mr. C. W. Earle, the chairman of the company, presiding.

The secretary, Mr. R. T. Brown, having read the notice convening the meeting, and also the minutes of the previous meeting, which were confirmed and signed, the chairman said:—"I presume, gentlemen, you will, as usual, take the report and accounts as read. ('Agreed.') As far as the accounts go, there is very little for me to remark upon, as they are very much the same as they usually are; and the only feature about them is one never absent from our reports, namely, the lamentable deficiency of revenue. To think that 4,000 miles of cable have been laid, and that we maintain 21 stations in the tropics, and that we only in the course of half a year carry traffic by which we receive about £25,000, is something quite unparalleled in the history of telegraph cables. It is not to be wondered at, however, when I tell you that at one of these stations we have only three people who use our cable, and that our station is therefore maintained for the benefit of these three gentlemen only. It is not wonderful that the revenue is a very poor one. The question then arises, how is it that so much capital has been invested in such an unprofitable field as this is? I think, gentlemen, the answer to that is contained in the document which I hold in my hand. I do not go with those who always criticise the estimates given in a prospectus. Prospectuses are generally put forth by people in sanguine moments, in the hope that what they state will be fulfilled; but when it comes with a certain amount of responsible authority, as this prospectus certainly did, it has a different complexion to my mind altogether. This prospectus states that "Sir Charles Bright, who recently returned from the West Indies, made a report on the revenue derivable from telegraphs there. From estimates based on official reports of the actual income from the existing Cuba line, which is earning £60,000 a year, he fixes the probable receipts of a new line at £156,000 a year, and the working expenses at £20,000 a year." This £156,000 was estimated as our traffic from far fewer stations than we have at present, because other stations were added immediately after the formation of the company at the earnest desire of other colonies included in the enterprise. Who were the gentlemen who had endorsed this? In looking at the names of the directors I find that they are persons of the very highest standing in the West Indian trade and connection. I think that out of the whole number there are four gentlemen intimately connected with West Indian business, therefore I think that to a great extent the West Indies are responsible for the mistake; and it is nothing more than a mistake. Those gentlemen were no doubt actuated by the best intentions; they believed what they said in this prospectus, that we should have a revenue something approaching to what they put forth. It has turned out to be a most lamentable mistake. No doubt the colonists were very much indebted to those who induced the subscription of capital and so constructed lines which for so many years have served their purposes and enabled their merchants to economise. It has also been of great service to the Home Government and to the Colonial Governments, and of very great value to every merchant that works in these colonies. Seeing the manner in which this company was raised, and its unfortunate result—its disappointment as to traffic, I think, as the report says, that there is a certain amount of moral claim on the West Indies for the reconsideration of those contracts, the most onerous contracts ever entered into by a telegraph company, and for that purpose we have from time to time opened negotiations with them. (Hear, hear.) We have sent out three missions to the West Indies, and I am sorry to say the result has led to very little improvement in our position. It is a very difficult thing to negotiate with a dozen separate governments. When you have brought most of them into a favourable view you are thrown over by the final negotiations with one government, which is recalcitrant and obstinate upon the subject. We sent out Mr. Grosvenor; that was followed by a telegraph conference, which we hoped would have looked into the question and have seen if anything could be done for the company to improve its position and carry on its business more to its own satisfaction. The conference met; it did not enquire into the position of the company in the least, but it proposed a scheme to lay a cable to Bermuda and Nova Scotia. The scheme was submitted to the Home Government, and after some months' delay, owing to a reference of the matter to the Treasury and the postmaster-general of England, a very instructive report was issued by the postmaster-general and the engineer-in-chief of the postal department upon the West Indian question altogether. It is a very exhaustive report, and there are one or two passages which, with your permission, I should like to read to you. The postmaster-general says:—"Undoubtedly the company have had great difficulties to contend with." But Mr. Fawcett believes that the present board is striving to put the property on a sound basis, and notwithstanding the opinion expressed by the conference that the company had failed to meet the requirements of the West Indian Colonies, he fears they would have just cause to complain of Her Majesty's Government if they were now to substitute a rival company, especially as such a company would in all probability require not much less support in the way of subsidies as the present company laid claim to. No company could be reasonably thought to supply news, as this company is called upon to do, free of charge. No such information is supplied gratis by other companies, it is given in the interests of a class; and the company must in consequence lose a number of messages that merchants themselves would otherwise have to send off." Again, he says, in conclusion, "Mr. Fawcett would draw the special attention of the Lords Commissioners of Her Majesty's Treasury to the opinion of the engineer-in-chief that any cable laid under other auspices would practically not be safer than that of the existing company, and would urge the greatest caution before granting any support to any scheme involving such a risk. In some parts the depth of the sea is enormous, and recovery of a cable is problematical. As large a sum as £90,000 has been spent by one of the existing Atlantic cable companies in effecting the repair of a cable in less depth of water." I will also draw your attention to the concluding paragraph of the engineer-in-chief's report: "Nor is it apparent to me that new cables under the auspices of a new company would be any safer than the existing cables of the Panama Company. They would be liable to the same dangers, as they would be resting on the same bottom. They would be subjected to the same difficulties, and would be almost impossible to recover in case of repairs; and it cannot be supposed that the gentlemen promoting a new scheme would be in any better position, except that they might be supposed to be pecuniarily stronger and therefore better able to cope with the difficulties which would arise. When the West Indian and Panama cable was laid there in many cases existed no sufficient soundings for their guidance. Many of the errors which then existed have since been rectified, but the company has grown poorer and poorer, and its want of means has prevented it from carrying on repairs or the laying of new cables. Therefore I cannot but think that in some fashion or other an improve-

ment of existing means is preferable to incurring great and uncertain outlay for the purpose of doing that which might at any moment, by its failure, expose the colonists to lose communication. "I think it is very satisfactory to us that the report really does state, in as fair a way as should be expected from an official, how little hope there is for the West Indies getting anybody else to take our places. However, we felt that it was fair to us and the colonies, and to everybody concerned, that we should lay before the Secretary of State for the Colonies our views as to what should be done if we had sufficient support. The interruption of our cables is an annoyance no doubt to the colonies, and a very natural cause of annoyance. But every cable is liable to be interrupted, because the ground is so bad. But we thought that, if they chose to pay for it, we would lay them a new line, which would give additional strength to the whole system. We then had an interview with Lord Derby, who, in a very business-like way, discussed the whole thing, and, I think, saw that we really had a great deal to complain of, and that we had been rather unfairly treated all the way through. We know the difficulties of a minister in getting money in any way, and he is treading on specially delicate ground when he touches the finances of the colonies. He has no power to say—"You should provide funds;" and the conditions of government in England make it very difficult for him to help us out of the imperial exchequer. We all know, with regard to the Cape cable, that it required a Zulu war and certain disasters to urge the Government to come forward and give a subsidy which induced a subscription of capital to that great work. I may mention that while all this has been going on, these colonists whose representatives propounded such a magnificent scheme as a Bermuda-Nova Scotia line, are in such financial difficulties themselves that commissioners have been sent out to enquire into the condition of their finances. Lord Derby has intimated to us that with regard to the proposals submitted to him he must wait until he sees the commissioners, who only returned the other day. So that there is nothing for it but to leave the matter in that position—not a very hopeful one. We have done all we can in the matter, and are entirely at the mercy of the colonists and of the Government. We have pressed these matters upon them in the most patient and persevering way, and we must leave to their judgment and decision, to their sense of honour almost, whether they will support us or not. Referring, in conclusion, to the reserve fund, the chairman said that they had put £15,000 to reserve. They felt it their duty to do so, as their expenses were heavy, and their Jamaica cable would be costly if they determined to repair it. He begged to move the adoption of the report and accounts.

Mr. William Ford seconded the motion.

Mr. George Barham asked why they had met on the Derby Day. (Hear, hear.) Also, why were they so long in getting out their accounts? After cordially endorsing the proposal to increase the reserve fund, Mr. Barham urged the necessity of close attention to the details of the expenditure, especially on repairs. An item of £31 10s. for auditing the accounts he considered extravagant, as he believed the monthly amount to be audited was only £200. He thought, also, the directors might forego a little of their large remuneration during this season of depression. The balance of £10,000 at their bankers was surely too large a sum to be lying idle. As to the items for repairs, he hoped that everything was done to lessen the risk of such breakages.

Mr. Alfred Morton thought much might be done by a closer check on the items for repair and management, as these occurred beyond the range of the London management.

Mr. Griffiths said that the opposition to them set up in the colonies was not a credit to their legislators. If the colonies actually began to work a counter scheme they would find themselves in as deplorable a condition as they themselves were in. He thought they ought to reduce expenses as much as possible, and he would like the directors to express their sympathy in a practical way for the shareholders by handing over a portion of their fees towards a dividend.

Mr. Robinson Kendal defended the policy of the directors as to the reserve fund.

A Shareholder asked if there was not some way of putting the screw on these colonial gentlemen (laughter). Hope deferred was making the heart of the preference shareholders sick.

Mr. Coombe said the company appeared to exist for the benefit of the colonists alone. He thought the preference shareholders might have had a small dividend out of the sum added to the reserve. He did not see why they required two ships to look after their cables, surely one efficient vessel would be enough.

The Chairman said that it was absurd to think that one ship was enough for 4,000 miles of cable. As to the forwarding of their accounts, the date had always been in May and October, and their remittances from the West Indies usually came in the form of 90 days' bills, which required time to negotiate; so he did not see how they could very well be much earlier. They had nothing to reproach themselves with about expenses of management. They were excessively economical; it had troubled his peace of mind sometimes to consider the way in which they had to economise with their employés. The audit charge complained of was very small considering the variety of the returns and their actual amount. The breakage in their cables had always arisen from friction upon rock. The bed of the ocean was volcanic, and the cable hanging between peaks was very liable to be worn through. The expense of recovery was frequently enormous; in 1,700 or 1,800 fathoms they might lose £500 worth of rope at one operation. The £10,000 at the bankers represented the whole of the cash at all their twenty-one stations, which was nothing extravagant. They could not withdraw from one of their stations; they would have to stand the shock of legal actions immediately for breach of contract. The company, in fact, had not got a stick to beat the colonists with. As to directors' remuneration, he did not see that they were called on to decrease it, as they might have if they had been parties to the original prospectus. They had, besides, entered office when the company was at quite as low an ebb as at present.

On the motion of the Chairman, seconded by Sir James Anderson Mr. Henry Holmes was re-elected a member of the board, as was also Mr. Henry Weaver on the seconding of Mr. Andrews.

John George Griffiths, Esq., was re-elected auditor, at a remuneration of 40 guineas, on the motion of Major Wood.

The meeting was concluded with the usual vote of thanks to the chairman.

The Electric "Sun" Lamp and Power Company (Limited).

A GENERAL meeting of the shareholders was held at the Cannon Street Hotel, on Wednesday, Lord Brabourne, the chairman of the company, presiding.

The secretary (Mr. J. Reeve) read the notice convening the meeting.

The report was taken as read. It said:—The directors have the honour to submit to the shareholders their first report, showing the present position and prospects of the company. They do this before a whole year has elapsed, as they are most desirous that the shareholders should be fully aware of the position of the company. The organising of the electrical staff was the first duty of the board, and at the urgent recommendation of Mr. Clerc, the inventor of the lamp, two gentlemen were appointed, in whom Mr. Clerc had confidence, one of whom had been engaged with him for some years. Some difficulties having been met with in the early part of this year with the details of installations, the board arranged with Mr. Clerc to come over for three months and superintend the working of the electrical arrangements. That gentleman is accordingly now in London and employed on the company's business. The obtaining a proper supply of machinery, especially of suitable dynamos, was a matter of some difficulty and delay. It was found that the alternating Gramme dynamo, somewhat modified by the inventor of the "Sun" light, gave the best results; but it was not till February in this year that an adequate number could be supplied. The manufacture of the lamp was also proceeded with, but the improvements which had been made in it by the inventor to render it more adaptable to different purposes and modes of lighting occupied a considerable time. The company has, however, now a large supply of lamps of the most approved type. With a view to obtain business, the directors issued a circular to manufacturers, &c., offering to instal the "Sun" lamp for a nominal fee, varying from £52 10s. for six lamps for three months, with the idea that if the lamp was approved, as they believed it would be, the apparatus would then be purchased. They felt that this was a fair and reasonable way of promoting the objects of the company, and better than offering to light up exhibitions and similar places free, as an advertisement. In this way installations were arranged for in Wolverhampton, Bradford, Doune, Salford, Nottingham, and Glasgow, some of which have been carried out, and the remainder are in progress. The installation of six lamps at a large iron works in Bradford has been so successful that six more are now being arranged for, and the directors believe that in this part of England especially there is a great field for profitable business for the "Sun" lamp. Concurrently with these provincial installations the directors have been actively engaged in organising the No. 1 Central Station for installing the "Sun" lamps from house to house in Regent Street and Oxford Street. Excellent premises were obtained in September in Riding House Street, at the top of Regent Street, engine power was laid down, and application was made to the Marylebone Vestry and the St. James's Vestry for leave to apply to the Board of Trade for a licence to light up that part of London. The directors have much satisfaction in reporting that applications supported by the vestries are now before the Board of Trade for licences to enable this company to light up one of the best parts of London, including the upper half of Regent Street, Oxford Circus, part of Oxford Street, and neighbourhood. In addition to this the board has entered into an agreement with the authorities of the South Kensington Museum to light a considerable part of that institution, and the works necessary for this are in a forward state. The directors are most anxious that the shareholders should be fully informed concerning the financial position of the company. Up to the present it is obvious that in order to establish the business on a firm basis, and to make it remunerative to the shareholders, considerable expenditure has been necessary. The amount of £20,226 which has been paid up upon the 7,759 shares subscribed by the public to this date will not be sufficient to enable the board to complete the central station, the South Kensington Museum installation, and the other works in hand, including the districts for which licences will be obtained. In consequence of the large amount of business already offered to the company, and the still larger amount in prospective the board recommend that a call of 20s. per share be now made, but though fully empowered to make this call under the articles of association, they prefer, previously to doing so, to meet the shareholders in general meeting, so that any further explanation may be given. If the Central Station is as successful as it is hoped it will be, so as to render it desirable to light it all over and to extend the system, additional capital beyond what is already subscribed will be needed to lay the mains and supply electricity to all the streets embraced in a larger area, which will no doubt be readily obtained. It will be offered to the present shareholders in the first instance. The directors, though unwilling to refer to themselves, think it right to state that with the exception of one of their members, who they requested to act temporarily as managing director, they have up to the present time taken no fees. The work of the company has, however, been of an arduous nature, and they consider that it will be fair that they shall receive one-half of their remuneration, and they will be content with the same rate until the company shall be in a dividend-paying condition.

The Chairman said he was very sorry that it should so happen that they should have fixed that meeting to be held on the anniversary of a great festival attended by a large number of their countrymen. He was sorry to say their directors were so ignorant of racing and its

concomitants (laughter, hear, hear, and no, no) that they really were not aware that they had fixed the meeting for the Derby Day (A shareholder: A most inconvenient day). They were told Derby Day would be the 30th of this month, and they fixed on a day a week earlier, intending to avoid it. On discovering their mistake they thought it better not to alter the date. He dared say, although they might object to the actual day fixed, they would hardly require an apology from him on the part of the directors for having called them together at that early period. They knew probably that the statutory meeting of the company had been held at the end of October last, the directors were under no obligation to call them together until the end of the present year, but he was strongly of opinion, and he was happy to say his colleagues agreed with that opinion, that it was very desirable under the existing circumstances of the company that they should meet at that particular time. In regard to every company with which he had the honour to be connected, it had been his earnest desire that there should be the fullest confidence between the shareholders and the directors, who were their servants, and it could only be obtained by a determination on the part of the directors to be as open as possible with their shareholders, keeping nothing from their knowledge, and calling them together for the purpose of consultation and of giving them information when they deemed necessary, and not abiding strictly by legal requirements. Well, it was very unfortunate, but more unfortunate perhaps as regarded himself than as regarded their interests, that he was struck down with illness last year and was unable to be present at the meeting of allotment or at the subsequent statutory meeting. He had, however, previously agreed with his colleagues as to the conditions of the allotment. Those conditions were fulfilled, and although he very much regretted he had not the opportunity then of discussing finally the details of the arrangement entered into, still he was bound to say he thought then and he thought now that with their prospects of success they were fully justified in launching the company (no, no). He thought gentlemen would do well if they would listen to the end of the plain and straightforward statement he was about to make, and he thought they would then come to the conclusion that he was not very wrong in making that remark (hear, hear). In launching the company, the directors acted, as they believed, in the interests of those who had consented to contribute money to it, and had not any doubt of the ultimate and entire success of the undertaking (hear, hear). With regard to the statutory meeting, at which he was unable to be present, their vice-chairman (Sir James Carmichael), who was a gentleman well known probably to most of them, was able to attend—he was sorry to say he was absent from this meeting on account of ill-health—and made a clear and full statement regarding the then position of the company, and by the directions of the board there was sent to every shareholder an accurate verbatim account of the proceedings of that day, so that every one had full opportunity of making himself acquainted with the state and position of the company up to that moment. Before he allowed his name to be connected with the company he made every possible inquiry, and satisfied himself, as far as any man who possessed no special knowledge of electricity could satisfy himself, that this "Sun" lamp was likely to be a great success. That was not only his opinion and the opinion of others who saw the manner in which the vaults beneath the Exchange were lighted last year, but it was the deliberate opinion of men who made electricity their study and its development their profession, and he felt bound to say he had up to that moment no reason to recede from that opinion. No doubt the question might be asked, as it had been asked already, if their lamp was so good how was it they had seen a great deal about the movements of other companies in the newspapers and very little about the "Sun" lamp; how was it they had had lectures on electricity, exhibitions of the electric light, large buildings lighted by it, in which other companies had taken part and had appeared prominently before the public while they appeared to have kept aloof as if their lamp had gone out altogether. In the answer to that question lay the declaration of the policy their board had thought right to adopt and now asked them to endorse. They felt, though they had got so good a lamp as they believed and still believed they could make efficient, it was wise on their part not to waste their money in unremunerative lights or sensational exhibitions. He did not for an instant mean to blame the conduct of other companies. No doubt other companies had acted as they thought best in the interests of their shareholders, and perhaps some of them had felt that the merits of their lights were not so likely to be discovered if not continually pressed on the public notice and recommended as they knew best how to recommend. Then they thought it best, moreover, considering electricity might be said to be in its infancy, to endeavour to make their lamp as perfect as possible, and to adopt such improvements as were from the first suggested, rather than hurry prematurely before the public before attaining to that position to which they had now attained. Their object had been to lay the basis or foundation of future prosperity so firmly and securely that when the fabric was erected there should be no chance of its overthrow. They must not think because they had not paraded themselves before the public that they had been neglectful of pushing the invention in every legitimate way and in a manner which they thought most likely to secure its success. They had tried to do that both in London and in the country, and in the country they had been laying foundations for extended work, hoping it would meet with success and that its progress and extension would be large and rapid. It was not his purpose to enter himself into the details of the work which had been carried on in London, and also in the country, in the advancement of their lamp, and for this very good reason. Early in the autumn of last year the directors came to the conclusion that it was most desirable to appoint one of their number as managing director, in order to inspect closely the details as to the machinery, the manufacture of the lamp, the installations and all the other everyday work; and they were fortunate to secure the services of Mr. Bartley, and he did not think a more fortunate selection could have been made. Mr. Bartley had assiduously and earnestly attended to the business of the manufacture of that lamp, and its introduction into the world. He had paid the greatest attention to it, and he felt that it would be better that he should leave Mr. Bartley to explain in detail, and give information on any points connected with the actual working of the lamp, upon which he would be able to speak with a great deal of practical knowledge, and with an authority of unremitting attention to the subject. What he had principally to do, was to point out what had been the policy of the board up to the present moment, and what they considered to be the position and prospects of the company. They would see from the report, which had been presented to them, that they had endeavoured to work for their benefit, both in the country and in the town. As regarded the country, they would find in that report the principle on which they had worked. If any gentleman wished to inquire further as to that principle, and as to the details of the work, Mr. Bartley would explain. But the principle had not yet been fully tested; sufficient time had not yet been had for its development, but in a short time they should be able to give them particulars of several country installations, which, he thought, would recommend to their approval the policy the directors had thought right to adopt. The total expense of their country work and installations had been under £800, of which, of course, a considerable proportion was in the plant and materials at the different country places to which they had sent them. He now came to the London work, and of course he did not wish to conceal for a moment that it was in London probably that the question of their success would be tested and decided. Their Riding House Street premises were now lighted by their lamp, and those who visited these premises on the previous night would, he hoped, have been satisfied with the perfection to which they had brought it. Speaking of London, he must remind them that they had obtained the support of two vestries, St. James's and Marylebone, in their application to the Board of Trade for licences, and if these licences were granted upon the terms he hoped they would be, he did not think there could be any doubt of the success of the company. Upon that their success hinged. That brought him to the financial part of the question. They must expect in the first two or three years expenditure which could not be immediately remunerative, but money judiciously expended became remunerative if the company was a success; and if he was right in his premises he thought they must take a great deal of comfort to themselves. They knew the part of London they proposed to light—St. James's and Marylebone—and he needed hardly say if they succeeded as they believed they should, and if the Board of Trade licences were granted on fair terms, they had before them a very large business, as much as they could undertake with their present capital, and it most decidedly must be a remunerative business, so that if they expected that they must not be afraid of the hardships they must go through before they arrived at that period. What their directors wished more particularly to do was to show them that the expenditure of their money up to the present time had been wise and careful. The subscribed capital of the company was nearly £40,000. Of that they had received just half, and he would tell them exactly what had been expended. £19,000 had been expended in this manner: £7,500 went to vendors; £500 in absolutely necessary stamps to legal documents; and £8,000 in plant, lease of premises, and in various properties. Therefore all that had been spent besides was £3,000. Of that £1,900, or about two-thirds, went in the wages and salaries of the officials conducting the actual work of the company; £500, in round numbers, in rents and taxes, leaving £600 for postage, stationery, advertising, travelling, and other incidental expenses. He did not think any other similar company could compare financially so favourably with them at the end of the first year of its existence. He concluded by formally moving the adoption of the report.

In reply to Mr. Jones, the Chairman said the lighting of that part of the South Kensington Museum with which they had been intrusted was in a forward state.

Mr. Milburn seconded the motion.

A Shareholder asked if it would not be desirable that the managing director should furnish them with information on the matters to which the chairman had referred.

Mr. Bartley said he would commence with the South Kensington Museum. Their scheme there was the lighting of a number of the picture-galleries, the Jones Bequest rooms, and four or five long galleries, with forty lamps. They were to be paid the same price as was there expended for gas, and they calculated on a profit of something like £100 to £150 a year; but they were not to be contented with the forty lamps, for if they met with success they were to light up a good deal of the remainder of the museum, and the result would be more profitable still. The museum authorities would have the right to buy up the plant. The central station had been a source of great expenditure, as they were bound to have the most promising place they could for a station, and show they were prepared to light up a considerable portion of the part of London in which it was. He had no doubt the Board of Trade would grant them a licence. With regard to the country installations, the plan they adopted was to charge a small fee, believing there was no doubt that if their lamp was successful people would buy it. They had lighted up part of a large ironworks at Bradford, and had given such satisfaction that there was a probability that the whole of the works would be lighted by them. What had created trouble and delay during the year had been the manufacture of the lamp and the getting of dynamos. Now, however, that they had a fair stock they were ready for their autumn campaign. He might mention that in the North of Scotland a trial of their lamp was going on by water-power, and if it was successful they might look to having a large field for useful and profitable business there.

In answer to questions by shareholders,

Mr. Bartley said he thought it would not be advisable to delay the call until the Board of Trade had settled the question of the licence, as if they did so their business would have to come to a standstill, and that would be a very unsatisfactory position for a company to be in. There was not, he considered, any doubt about their getting the

licence. A deputation representing the vestries which supported their application for a licence had visited their works and carefully inspected the light. Their lighting of the South Kensington Museum with the 40 lamps would be effected in perhaps three weeks. Their stations would be available for lighting private houses within a half or three-quarters of a mile of each. The only provincial installation of theirs that had run out was the one at Wolverhampton. In this place they had had some difficulty which arose in consequence of their being a little unwise in allowing the people there to have the installation before everything was absolutely ready. To make the company a success, and to extend it as they hoped to extend it, he thought would require a great deal more than £200,000.

The Chairman said that if they extended their operations it would be in consequence of their success. The capital would bring a good return, and therefore nothing could be better than that they should extend their operations.

On the motion of Mr. Jones, a vote of thanks was awarded to the chairman and directors, and the meeting separated.

The Maxim-Weston Electric Company (Limited).

AN extraordinary general meeting of this company was held at Cannon Street Hotel on Friday of last week, to take into consideration, and if deemed expedient, to accept the resignation of the directors and "to elect other directors in the place of any director or directors whose resignation may then be accepted or who may decline to continue to act as director of the company;" and also to confirm the special resolutions which were formally passed at the extraordinary general meeting of the company held on the 4th inst.

The Secretary (Mr. T. R. Comyn) read the notice convening the meeting.

Mr. Allender (to the chairman): Before we proceed to the general business of the meeting will you allow me to ask you one or two questions?

The Chairman: Certainly.

Mr. Allender: A circular has been issued to the shareholders from 47, Cannon Street, the offices of the company, signed by Mr. Hugh Watt. That circular contains some positive assertions, particularly in regard to figures. Is it, may I ask, to be recognised as an official circular?

The Chairman: No. The board of directors as a body knew nothing of this circular. It was not sent to us, and I only saw it accidentally, it having been sent to me by a shareholder who asked a question in regard to it.

Mr. Allender: May I ask, do you, as chairman of this company, endorse the figures given by Mr. Watt in that circular?

The Chairman: Most certainly not. If I did I should have been very faulty in not having submitted those figures to you at a previous meeting, and thus having acquainted the shareholders that we are now making a profit at the rate of £10,000 a year.

Mr. Allender: I should like to say, as a member of the late committee, that I do not believe in those figures, I cannot endorse them and I challenge Mr. Watt to prove their correctness before a committee of the shareholders of the company. If Mr. Watt is right and I am wrong, I shall ask Mr. Watt's pardon; but if Mr. Watt is wrong then it will be for those gentlemen who have supported him by giving him their proxies to ask whether those proxies have not been obtained by unfair means.

Mr. Watt said it was not correct to say that the proxies were got on account of those figures. On the occasion of the previous meeting he held proxies for 30,000 shares, and now he held proxies for 50,000 shares; but these proxies were not secured by means of that circular, but chiefly at his own expense by personal canvas. His figures were based on information contained in a letter dated 10th July, which he received from the then secretary of the company, and also on information he had received from the accountant of the company; and any shareholder who visited the company's offices would be at liberty to examine these figures. Mr. Allender was very anxious to get him and Mr. Swaby out of the board, so as to get himself and some other gentleman on it; but what were Mr. Allender's qualifications for the position? He (Mr. Watt) had no objection to resign his position in favour of any qualified man, but——

The Chairman: Let us avoid personalities.

Mr. Watt said the chairman seemed very anxious for personalities on the one side, but not on the other. He challenged Admiral Inglefield or any one else to deny the accuracy of the figures.

A Shareholder said the circular was sent to him and his proxy solicited in consequence of it.

The Chairman (referring to the circular) reminded the meeting that the manufacture of lamps and their sale were two very distinct things, and that when they had a large quantity of lamps in their stores they must not call them profit until they were sold.

Mr. Watt: They were sold.

The Chairman hoped Mr. Watt would allow him to go on. He should read to the meeting a very important letter which he had received from Mr. Kabath. Mr. Kabath, as they perhaps knew, was the gentleman who, on the part of the American Company, sold to the Maxim-Weston Company the Maxim and Weston Patents. He (the Chairman) wrote Mr. Kabath, suggesting that he should allow himself to be nominated for election as a director of their company, and the reply he received, which was dated the 15th inst., was as follows:—

"SIR,—Answering your request for me to join the board of the Maxim-Weston Electric Company, I will say that I have no objection to join the board with yourself as chairman, and such other parties as you have named to me already as members of the board; and I feel certain that we will make as great a success of this business here in England as it is already in the United States, and, to some extent, on the continent. I don't see any objection to furnish you and your shareholders the information regarding our business in the United States and on the continent of Europe. Having just returned from New York, I have been enabled to see for myself what immense progress has been made during the past two years. We have got to-day, in New York alone, 5 central stations for the purpose of supplying light, each station is fitted with engines of 500 H. P., and ample space to allow for the duplication of the plant. We have also installations in the principal buildings; to mention a few, The "Equitable," "Hoffmann House," and about one hundred others. The company's works at Newark, New Jersey, cover a large area, and about one thousand men are employed; four dynamo machines are turned out daily, which forms a total of 1,200 dynamo machines alone per annum, and they have orders for 60 days ahead. The United States Electric Lighting Company paid to their shareholders last year a dividend of 5 per cent. on their shares, besides carrying over a large reserve. The stock of the United States Company is at 35 per cent. premium, but I doubt whether any large number of shares could be bought at that price, as nearly the entire stock is owned by five or six gentlemen of the highest financial standing in the United States, who, knowing they have a good thing in hand, are not likely to part with their shares. The sub-companies of the United States Electric Lighting Co., the New York Illuminating Co., the New England Weston Co., the companies in Pittsburgh, Louisville, Chicago, Charlestown and elsewhere, are doing equally well. Estimating roughly, as the business is steadily increasing all the time, I can say that there are not less than 20,000 Weston Arc lights in actual daily operation throughout the United States, and not less than 50,000 Maxim Incandescent lamps. I think these figures speak for themselves, and I need not add anything to their significance, but I must remark that the business in store for the United States Company is much larger than anything that could be to-day foretold. Messrs. Weston and Maxim are the ablest electricians living to-day. Mr. Weston is now actively engaged in bringing out a complete system for transmitting power by electricity. The experiments which I have witnessed myself were most conclusive, and I can say that you are possessing not only the best light but will also possess the best and most complete system of transmitting power. Being myself the owner of some inventions and the representative in Europe of the Maxim and Weston systems of electric lighting, I must not presume to criticise other systems, as my opinion could not be taken as an impartial one. I must, however, say that having overcome all the difficulties we had to encounter, both in America and Europe, in my opinion there can be no doubt that these two systems, Maxim and Weston, are to-day the very best, both for Incandescent and Arc lighting. From all the official tests made at the Paris Exhibition and elsewhere, the Weston dynamo machine yields about 15 per cent. more current than any other dynamo machine; the Weston Arc lamp has already established its superiority, while the Maxim Incandescent lamp is considered everywhere as the best in the market. Mr. G. W. Hebard, the chairman of the United States Electric Lighting Co., positively assures me that the average lifetime of a Maxim lamp is from 1,800 to 2,000 hours. No other Incandescent lamp can claim a duration of more than 1,000 hours. The renewal of lamps form an important item in working expenses, and the fact of its long life makes the Maxim lamp the most economical one. We have neither been idle on the continent. The strongest electric company in Paris, the "Compagnie d'Eclairage Electrique," whose chairman, Monsieur H. Fontaine, is one of the leading scientists and a most successful business man, have purchased our patents for France. It might interest you to know that the price paid by that company for the French patents was very nearly the same as that paid by the English company for the English patents. The French company is now working two systems, viz.:—The Jablochkoff for Arc lights, and the Maxim for Incandescents; they own also the Weston system, but could not work it, as the French law makes it obligatory to manufacture the apparatus in France. We have been most successful also in Spain, where there are some 40 or 50 plants of our Incandescent lamps in actual operation. The manager of the Spanish company, Mr. Dalmar, is one of the leading men in electricity. In Austria, where this summer a large international electric exhibition takes place, we shall be well represented, the United States Electric Lighting Company having already forwarded the necessary machines and apparatus. I might mention also that in Vienna we are the only incandescent light system to be seen, having two plants in successful operation for the last six months. In Italy both our systems are well represented. One of our incandescent installations has been visited by the Royal Family, and H.R.H. the Duke d'Aosta, brother to his Majesty the King of Italy, expressed a desire to have our light in his palace. We shall be largely represented at the coronation of the Czar of Russia. We have also a great many plants in operation in Germany, Sweden, Norway, Denmark, Belgium, and Holland. Out of all these I will only mention a very interesting installation of the Maxim light in the gas factory of Messrs. de Bruyn and Zonen, at Amsterdam. They have had these lights running for the last two years, and are using my accumulators in connection with it, the accumulators serving as regulators during the working hours, and furnishing at night the current direct to the lamps. To conclude, I will say that I am not of the opinion held by some gentlemen, that the present difficulty of the Maxim Weston Company, in London, is to be solely attributed to bad management. I think that the great difficulty that this company has had to encounter is insufficient capital. No manufacture can be fairly established without the means of establishing a factory, and it is also most essential to have ample funds for working expenses at the outset. This latter is a very important point with electric companies, as the capital must be laid out in plants, central stations, &c. We have up to the present been endeavouring to accomplish certain things which it was impossible to attain without the means necessary for their accomplishment. Can one imagine a gas company being started in London with a capital of £100,000 or £200,000? That is what has been tried, however, in the case of electric companies, trying to establish a large business with a small capital. This is a great mistake, as we have seen in several instances.

The capital of a company must correspond to the business it proposes to carry on, otherwise the concern will certainly end in failure. I have no objection to your using this letter in any way that might serve the interests of the shareholders of your company, and I am willing to furnish further information, and will say that in my statements I have certainly rather under-estimated the future of our business than exaggerated it. That electricity can be commercially employed is fully demonstrated by the United States Electric Lighting Company, and I have not the slightest doubt but that it can be similarly used in Great Britain if there are adequate means and the business be conducted with the same amount of enterprise as it has been in the United States.—I remain, sir, yours faithfully (signed), N. DE KABATH, General Agent for the United States Electric Company, and representing (by power of attorney) Messrs. E. Weston and H. S. Maxim, holder of 1,000 shares of the Maxim-Weston Company."

He had read that letter because he wished to say he thought if he obtained Mr. Kabath's permission to nominate him for election as a director he should be justified in doing so (applause). He signed the papers, as he thought, within the proper time, nominating Mr. Kabath and also Mr. Allender; but according to the Act of Parliament he was too late in signing these papers, and therefore these gentlemen's nominations could not be acted upon. He had therefore been obliged to seek another course by which these gentlemen might be elected, and they would now ask the shareholders to elect a certain number of directors, two of whom would be afterwards ready to retire, so that their places might be taken by Mr. Kabath and Mr. Allender.

Mr. Inverarity said he had sat on the board of the company for eight months and could assure the shareholders that there had been very little mismanagement on the part of the board (hear, hear). He moved that the chairman's resignation be not received.

Mr. Thomas seconded.

The Chairman had not the slightest wish to remain a director of the company; but when gentlemen like Mr. Kabath and Mr. Allender, and two or three others in the room, had begged of him to remain a director he gave way. If they chose to again elect him he should remain on the board conditionally on their having a board who could work and in the members of which he could place confidence.

The motion was then put and carried, there being only one dissentient.

Mr. Inverarity next moved that the resignation of Sir Herbert Bruce Sandford be not accepted.

Colonel Gilby seconded.

Sir H. B. Sandford said on coming to the meeting he had fully intended to insist on his right to have his resignation accepted, but if it were the unanimous desire of the meeting that he should remain on the board, he should do so for a short time in order to assist their chairman to set the new board going.

The motion was unanimously carried.

The Chairman: Not one dissentient! I think he ought to be chairman (laughter and cheers).

Mr. Inverarity next proposed that the resignation of Mr. Swaby be not accepted.

A shareholder seconded.

Mr. Treadway: What number of shares does he hold?

The Secretary: 3,000.

This motion was likewise unanimously adopted.

Mr. Inverarity suggested that instead of their going through all the other names they had before them, the three gentlemen who had been elected should go to the offices in Cannon Street and appoint, as they had promised to do under the articles of association, Mr. Kabath and Mr. Allender directors, and that these five gentlemen then determine Mr. Watt's question.

A shareholder moved and another shareholder seconded that the resignation of Mr. Scarlett Campbell be not accepted.

Mr. Gray opposed the motion. He personally examined the director's attendance-book for the year ending the 31st March last, and found that Mr. Scarlett Campbell had been absent from the board meetings four months during the year. That, in his opinion, constituted a fatal objection to his re-election. He moved that his resignation be accepted.

A shareholder asked how many directors they could elect.

The Chairman: Five or seven.

A shareholder seconded the amendment.

Mr. Scarlett Campbell, in reply to Mr. Gray, said with the exception of during his three months' holiday in Scotland, he did not think he had missed three board meetings in the whole year.

The Chairman confirmed this statement, and

Mr. Scarlett Campbell's resignation was not accepted.

A motion declining to accept the resignation of Mr. Watt was also agreed to.

Mr. S. Gray and Mr. John Brown were then unanimously elected directors.

The following gentlemen therefore now constitute the board:—Admiral Sir E. A. Inglefield, C.B., Sir H. B. Sandford, and Messrs. L. Swaby, J. S. Campbell, H. Watt, S. Gray, and J. Brown.

The meeting then confirmed the following special resolution passed at the extraordinary general meeting of the company held on the 4th inst.: "That the nominal capital of the company be increased by the addition thereto of 327,500 shares of £1 each beyond the registered capital of £172,500, in 172,500 shares of £1 each, making the total capital of £500,000," the board pledging itself not to issue more shares than would bring the capital up to £250,000, without again calling the shareholders together, and the market price being fixed at 5s.

A vote of thanks to the chairman closed the meeting.

Railway and Electric Appliances Co. (Limited).—A petition for the winding-up of the Railway and Electric Appliances Co. (Limited) is to be heard before Vice-Chancellor Bacon to-day.

NEW PATENTS—1883.

2189. "Electric telephones." H. J. ALLISON. (Communicated by J. H. Robertson.) Dated May 1.

2200. "Means of and apparatus for indicating the divergence of magnetised needles." G. C. COOKE. Dated May 1.

2250. "Dynamo-electric machines." O. WILLIAMS. Dated May 3.

2253. "Galvanic batteries." J. LEA. Dated May 3.

2268. "Apparatus for measuring the strength of electric currents." F. V. ANDERSEN. Dated May 4.

2280. "Dynamo-electric machines and electro-motors." SIR C. T. BRIGHT. Dated May 4.

2281. "Method of and apparatus for depolarising electrolytic baths in the refining and deposition of metals." A. M. CLARK. (Communicated by C. de Changy.) Dated May 4.

2304. "Automatic regulation at a distance of electric currents, of the distribution of water, gas, or steam, and generally of any fluid whatever." E. G. BREWER. (Communicated by La Société Anonyme des Ateliers de Construction Mecanique d'Appareils Electriques.) Dated May 7.

2322. "Transmitting and receiving telephones." C. W. HAYES and S. R. BECKWITH. (Communicated by M. L. Baxter.) (*Complete.*) Dated May 8.

2330. "Magneto-electric and dynamo-electric machines and motors." A. CLARK. Dated May 8.

2331. "Microphones or telephones." E. G. BREWER. (Communicated by R. Weber.) Dated May 8.

2337. "Electric lamps or lighting apparatus." A. SHEDLOCK. Dated May 8.

2338. "Electric tramways and vehicles to be used thereon." H. H. LAKE. (Communicated by C. Basto.) Dated May 8.

2339. "Dynamo-electric machines." H. H. LAKE. (Communicated by C. H. Palmer and A. M. Loryea.) Dated May 8.

2350. "Electric cells or batteries." N. C. COOKSON and J. SWINBURNE. Dated May 9.

2358. "Secondary voltaic batteries." A. PARTZ. Dated May 9.

2369. "Incandescent electric lamps." J. WARNER. Dated May 9.

2373. "Insulating supports for telegraph and telephone wires." S. WOOLF. Dated May 9.

2390. "Obtaining gold, silver, copper, and other metals from their ores by electrolytic action and apparatus therefor." C. D. ABEL. (Communicated by M. Body.) Dated May 10.

2395. "Contact boxes on electric railways." W. E. AYRTON and J. PERRY. Dated May 11.

2434. "New or improved means or apparatus for producing, distributing, and utilising electricity for lighting, motive power, and other purposes." E. L. VOICE. Dated May 15.

2437. "Differential gearing applied to electric motors and vehicles." F. WYNNE. Dated May 15.

2438. "Improvements in the manufacture of incandescent electric lamps, and in apparatus therewith connected." J. H. GUEST. Dated May 15.

2440. "Improved apparatus for reproducing at a distance the fac-simile of writing characters or any designs by electricity." A. T. COLLIER. Dated May 15.

2442. "Plates for secondary batteries." W. HOCHHAUSEN. Dated May 15.

2448. "Electric light buoys." E. C. G. THOMAS. Dated May 15.

2455. "Primary galvanic batteries." G. G. ANDRÉ. Dated May 16.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

3974. "Dynamo-electric power creating machines." J. E. T. WOODS. Dated August 19. 4d. The objects of the invention are to manufacture dynamo electric power creating machines on new, improved and economical principles, either for electric lighting purposes or for the transmission of power whereby increased effect, diminished weight and space, and consequent economy in the motive power employed is secured. The invention consists of improvements in several parts of the machines as well as the introduction of new principles in the machines themselves to those hitherto in use with the objects specified above. In the first instance the soft iron cores of the circuit magnets and of the field magnets (where soft iron is used) are formed of parallel lengths of the softest homogenous iron wire which may be of any size convenient to the purpose; these are tied in bundles and are heated nearly to welding temperature in pulverised oxides of iron by which they are rendered still softer. While still heated they are removed from the furnace and with as little exposure to the air as possible are passed through grooved rollers of suitable size or wedged on the anvil with a grooved mandril which has the effect of pressing the round wires close together, making them assume more or less a

hexagonal or six sided form without disturbing the direction of the longitudinal fibre of the iron wires used upon which the rapidity that the iron cores acquire and throw off their induced magnetism so much depends. The second part of the invention consists in winding the soft iron cores so formed as above for the field magnets or circuit magnets as the case may be with wire drawn through a square die and properly insulated by any of the well known modes now in use. By this arrangement greatly increased conductivity in the wire used is obtained with a diminution of space occupied by the coil (which under usual circumstances amounts to one fourth of the coil space employed) and thus *pro tanto* increasing the power obtained from coils of the same size as those wound with ordinary round wire. (*Provisional only*).

4034. "Generation, storage, distribution, &c., of electricity." J. S. WILLIAMS. Dated August 22. 2s. 10d. The object of this invention is to generate, store, distribute, regulate, and utilise electricity for the working of railways and tramways, and for other purposes, and the said invention relates to apparatus, methods, and means to be employed therefor or in connection therewith. (*This specification is too lengthy to admit of an abstract.*)

4454. "Transmitters for speaking telephones." W. P. THOMPSON. (A communication from abroad by G. F. M. J. W. Brown, and H. D. Hyde, of America.) Dated September 19. 6d. Relates to that class of telephone transmitters by means of which variations are produced in the strength of an electric current proceeding from a generator of constant electromotive force, which variations correspond in character to the vibrations, undulations, or waves accompanying the sound which is to be transmitted. Fig. 1 is a vertical

FIG. 1.

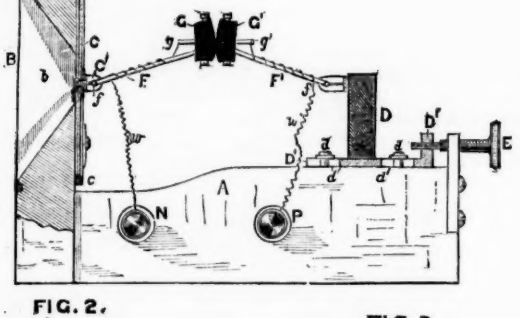
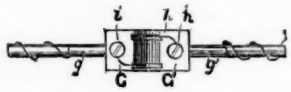


FIG. 2.

FIG. 3.



longitudinal section of an apparatus embodying this invention. A represents the base upon which the several parts of the apparatus are mounted. B is an upright wooden standard secured to the base, A, and having a conical mouth-piece, *b*, formed within it. An elastic plate, C, preferably of metal and of a circular form, is supported and secured at its edge by suitable clamps, *c c*, leaving its central portion free to vibrate in a well understood manner. This elastic plate is technically termed the diaphragm. D is an upright standard, preferably formed of non-conducting material, which is fixed upon a pedestal or foot, D^1, and this is attached to the base, A, in such a manner as to permit it to have a horizontal movement. This attachment may be made in the manner shown in the figure by means of screws, *d d*, passing through slots, d^1 d^1. The horizontal movement of the standard, D, in each direction is effected by means of an adjusting screw, E, of the usual construction. A lug, C^1, is rigidly secured to the centre of the diaphragm, C, by means of a screw or otherwise. A slender but rigid metallic rod, F, is pivoted at *f* to the lug, C^1, and carries at its opposite extremity a rocker, G, of non-conducting material. Another similar rod, F^1, is pivoted at f^1, to the adjustably fixed standard, D, and carries a similar rocker, G^1. The rods, F and F^1, are not situated parallel to a line passing through the axis of the diaphragm, but are inclined upward toward each other at an angle of about 20 degrees from a horizontal plane. A metallic wire or rod, preferably of platinum or iridium, is inserted in each of the rockers, G and G^1, passing horizontally through the same. These metallic terminals form the electrodes of an otherwise uninterrupted electric circuit as hereinafter explained. The ends of the respective electrodes, which face each other, are convex in form, the curve of their convexity corresponding with and being a continuation of the curved faces of the rockers which serve to support them. The curved faces of the respective electrodes must not be in actual contact with each other, but must be separated by an exceedingly small space. The rockers are linked together and firmly held in their proper relative positions, by means of flexible wires (fig. 2). Thus a wire, *k*, is secured at its upper end to a screw, *h*, inserted in the top of the rocker, G^1. The lower end of the wire, *k*, is secured to a screw, h^1, at the bottom of the rocker, G. In like manner a wire, k^1 (see fig. 3), extends from the upper screw, *i*, of rocker, G, to the lower screw, i^1, of rocker, G^1. The length of these wires is capable of adjustment, by turning the screws *h* or *i*. It will thus be understood that the position of the rockers, G and G^1, with reference to each other may be adjusted with such delicacy that the convex faces of the respective electrodes, *g* and g^1, may be brought and maintained in their required relative positions, without actual contact. Hence if the diaphragm, C, be caused to vibrate to-and-fro as by the impingement of air-waves thereupon, the rockers, G and G^1, will be caused to move in a corresponding manner, but in a direction nearly vertical. The curved faces of the electrodes, *g* and g^1, are parts of circles which are eccentric to the axes, *f* and f^1, upon which they move, hence it necessarily follows that the relative motion of the two electrodes towards and from each other, must be similar in character to but of much less amplitude than the motions of the centre of the diaphragm, C. The actual motion may be varied with reference to its ratio to that of the diaphragm, C, by varying the angles formed by the rods, F and F^1. The greater the angle of the rods, F and F^1, above a horizontal plane, the less will the relative motion be. The rockers, G and G^1, being linked together by the wires, *i* and *k*, in the manner hereinbefore described, it is evident that any motion, of whatever character imparted to one, must necessarily be communicated to the other. The electrodes, *g* and g^1, are respectively connected to binding screws, N and P, by means of wires, *w* w^1, which may, for convenience and safety, be wound spirally around the rods, F and F^1, as shown in fig. 1. The wires for connecting the transmitting instrument with the receiving telephone are attached to the binding screws, P and N, in a well-known manner.

4458. "Carbon conductors for electric-lamps." W. R. LAKE. (A communication from abroad by E. Weston, of America.) Dated September 19. 4d. The object of this invention is to produce a carbon conductor, adapted particularly for incandescent electric lamps, which shall possess flexibility in a high degree, and which shall be dense, solid and of even resistance throughout. To this end, there must be employed a structureless or amorphous and homogeneous substance, but this substance must be of such a nature, that it will, unlike other amorphous bodies, whose use has been heretofore essayed, preserve practically unimpaired its uniform density and solidity, without appreciable change, so far as concerns this characteristic in the arrangement or disposition of its component elements. These conditions are realised in a substance or compound, that can be produced readily and inexpensively from cellulose, such as is easily obtainable in the form of cotton waste, linen, paper and the like, and which may be termed non-fibrous, or amorphous cellulose. If cellulose, that is to say, cotton, cotton waste, linen or paper, be subjected to the action of a mixture of nitric and sulphuric acid, the result is a substance, which though fibrous, and possing in some other respects, nearly the same physical qualities as the pure cellulose, differs radically from it, being explosive, and burning without appreciable residue. This substance is commonly known as pyroxyline, gun-cotton, or nitro-cellulose. By dissolving this with a mixture of ether and alcohol, collodion is produced. By treating it with various other solvents, such as nitro-benzol, naphtha, camphor, and other well-known solvents, the substance known as celluloid is produced. Both collodion and celluloid may be formed in thin sheets and dried, but so long as the characteristics of the nitro-cellulose remain, they are both unfit for the production of carbons for the reason that they burn without residue. In order, therefore, to render them suitable for his purpose, the inventor de-oxidises them, so to speak, or in other words, he treats them with such chemical agents as will deprive them of their nitrous qualities, and bring them back to the chemical condition of cellulose. Among such reducing agents may be mentioned ammonium sulphide, protochloride of iron, sulphate of iron and others. The sheets of collodion or celluloid, when exposed to the action of these or similar reducing agents, are brought back to their original chemical condition, but in many other respects present the physical appearance of celluloid. They become transparent, very tenacious and flexible, and carbonize slightly less readily than ordinary cellulose. From these, the inventor cuts or stamps the conducting strips in the usual manner. After being cut and shaped they are carbonised in the same manner as heretofore practised in the manufacture of carbon conductors and the process is then complete, and the carbon is finished and ready for use without further treatment.

4460. "Batteries for generating electricity." G. G. SKRIVANOW. Dated September 19. 6d. Relates to the battery described in the No. of the ELECTRICAL REVIEW for April 7th, 1883.

4492. "Apparatus for producing and regulating electric currents, &c." A. R. SENNETT. Dated September 20. 1s. 6d. Relates to apparatus for the conversion of mechanical into electrical energy the methods of regulating the same, more particularly for the production of the electric light, and to the lamps, fittings, and apparatus employed in its application to various purposes.

4503. "Apparatus for governing electric currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21. 6d. The apparatus for regulating or governing electric currents consists of a suitable trough containing any electrolyte, two or more conducting plates, both or all movable, or one set stationary the other movable, all or any placed in a vertical, horizontal, or other direction. The plates, which may be solid, perforated, or built up, are to be moved and retained by suitable means in the desired position in the said trough in which the electrolyte is maintained at a constant level, and convenient appurtenances used for retaining the plates in such desired position therein, so that by bringing the plates, or sets of plates, nearer to each other, or removing them a greater distance, or immersing them more or less in the electrolyte, the current passing through the electrolyte by means of the plates, or sets of plates, is controlled or governed. Also in the means for moving and retaining said plates, either by a rod, or rods, attached to the plate, or sets thereof, worked in a stuffing box, or by a rack and pinion, by springs, or by counterbalanced weights and pulleys, or by other equivalents—said appliances for moving being actuated automatically by a solenoid with sucking-magnet and spring, or by an electro-magnet, or magnets, releasing one or more armatures and thereby causing one or more electro-motors to work the appliances.

4504. "Apparatus for measuring electric force and currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21. 6d. The apparatus consists of a solenoid and sucking magnet with a counterbalancing spring, or an electro-motor or motors with armatures capable of being moved, working by any well-known mechanical device a pencil or style brought into contact with paper or other equivalent, and so marking the movements of the sucking magnet, or electro-motor and its attachments put into motion by the electric current passed through the coils of the solenoid or the electro-motor. The paper or material to be so marked is made in a continuous roll or rolls, and is actuated by clock mechanism, and thus the duration as well as the force and quantity of the current registered.

4511. "Apparatus for storing, measuring, and regulating electricity." J. D. F. ANDREWS. Dated September 21. 6d. In constructing an electric accumulator the inventor encloses the elements in a tight casing, which may be divided into compartments, so that the gases produced are retained, increasing the pressure. The pressure within the accumulator, as indicated by a gauge, serves as a measure of the electrical charge. For the purpose of maintaining continuous supply of electricity and regulating it, two accumulators are provided, which in this case may be open and charged successively from the source of electricity, discharging them successively into a third accumulator, the alternate charging and discharging being automatically effected.

4512. "Portable voltaic batteries." J. MACKENZIE. Dated September 21. 4d. Relates to the construction and arrangement of a chloride of silver battery cell, so as to be powerful in its action, tight against leakage, and conveniently portable. For this purpose the inventor fits a short cylindrical tube of copper, brass, or other suitable metal with a cap of the same metal screwed on one end, and with a cover of ebonite or other insulating material screwed on the other end, the joints being made tight by washers of leather, or other packing material. He electroplates with silver the interior of the tube and its metal cap, and on this silvered surface he fixes by fusion a layer of chloride of silver. In the ebonite cover, and passing through it, he screws a zinc pin and to the head of the pin, which is inside, he secures by a zinc rivet a tube of zinc or amalgamated zinc, which extends nearly to the bottom of the cell, leaving an annular space between it and the interior surface of the chloride of silver. The cell being charged with suitable exciting liquid, such as solution of sodium, sulphate or chloride, or zinc chloride, the ebonite cap is screwed on tight, and the conducting wires for the external circuit are connected respectively to the exterior of the tube, and to the zinc pin which passes through the ebonite cover.

4525. "Manufacture of secondary batteries or accumulators." F. M. LYTE. Dated September 22. 4d. The inventor constructs the electrodes in two distinct parts, viz., a central portion, which may consist of porous carbon plate, a network of carbon, or a built up tissue or network of carbon or some form similar to these, woven or built up of lead, and he surrounds such porous plates, networks, or tissues of carbon or lead with a firmer and more solid frame preferably of carbon or lead, but which may be of any other suitable conducting material. This external frame and the plates or tissue of carbon or lead are made separately, the plate or tissue, &c., being introduced, adapted to, and fixed in the frame subsequent to their manufacture.

4527. "Electro-magnetic engraving machines." B. J. CARTER. (A communication from abroad by G. McKendree Guerrant, of America.) Dated September 22. 6d. This invention relates to electro-magnetic machines for engraving or cutting letters, figures, or other characters on wood, metal, or other material, and comprises various improvements.

4532. "Regulating currents from voltaic cells and to and from secondary batteries, &c." W. E. AYRTON and J. PERRY. Dated September 23. 8d. When a variable number of voltaic cells or a variable number of secondary batteries are being charged or discharged, it is usual to have the cells arranged so that the positive pole of one cell and the negative pole of the next are permanently connected together, and the insulated studs of the commutators are respectively connected with these junctions of positive and negative poles, so that two movable contact pieces which are attached to the two ends of any circuit enables their being placed one on any one of the studs of the commutator and the other on any other one of the studs, and so that all the cells existing between these two studs in question are charged or discharged through the circuit of which we have spoken. Now, as the number of cells is altered by the sliding or rolling of one or both of the contact pieces, either the contact piece leaves one stud completely before it touches another, in which case the circuit is temporarily broken and the current interrupted, or else the contact piece before entirely leaving one stud touches the next. In this latter case the circuit is not interrupted, but the cell or cells which are being added to or subtracted from the circuit are temporarily short-circuited through the contact pieces and are consequently damaged, or at any rate most unnecessarily discharged, and highly injurious sparking occurs. The inventors' improvement consists partly in substituting for each of these single movable contact-pieces a contact-maker consisting of two or more metallic pieces which together form the contact-maker, and which are connected together through a resistance coil or coils which moves or move with them. One only of these contact pieces of each contact-maker is connected with one end of the circuit referred to above, and through which the cells are charged or discharged. When a contact-maker consists of two contact-pieces they are so arranged that when they are moved together neither of the contact-pieces can touch two adjacent studs of the commutator at the same time, but the front one touches the stud in advance before the hinder leaves the stud which is being left. Hence first the circuit is not broken, and secondly the cell or cells that are being added or subtracted are not short-circuited; and further as they are added to the main circuit, first, through the resistance coil, and, secondly, directly the alteration in the current is more gradually produced than is the case with the ordinary forms of commutators.

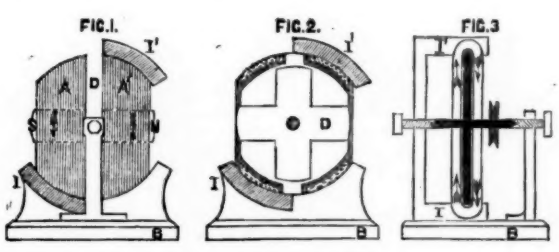
4535. "Dynamo-electric machines." F. C. GLASER. (A communication by C. Zipernowsky and M. Deri, both of Austria.) Dated September 23. 10d. This invention relates to the construction of machines which combine the functions of an ordinary dynamo-electric machine and a reversed current apparatus, that is to say, it produces alternating currents, but is so arranged as to supply its inducing electro-magnets from its own currents. It has for its object, firstly, to excite, by peculiar arrangements, its own electro-magnets, according to requirements, by means of continuous or intermittent weaker currents of the same direction; and, secondly, to furnish a reliable and durable current-producer, applicable to the various requirements of electric lighting, by a peculiar and effectual construction of the induction apparatus in which the currents are produced, and a secure connection of the various parts. In order, furthermore, to attain a perfectly reliable working, in particular when incandescent lamps are introduced into the main current in parallel arc, a new mode of generating the electro-magnetism by differential excitement is employed, which enables the energy of the current to be decreased or increased automatically in exactly or approximately the proportion required by any variation in the number of the lamps in action. It is also an important feature of the present invention that the very powerful working currents are led off from fixed contact screws without commutation and without the aid of movable contacts, while only the weaker magnetising currents are turned into the same direction, either in passing or in a shunt, in order to render them available for exciting the electro-magnets. The main or working current passing through the circuit remains an alternating one.

4548. "Mechanism for transporting by electricity, &c." FLEEMING JENKIN. September 23. 10d. This invention has for its object improvements relating to mechanism for transporting goods and passengers by the aid of electricity, and the regulation of the speed of machinery driven by electricity. In regulating automatic electrical transport, it is desirable in the first place to adjust the speed of each vehicle or train to a given rate, so that the line may be filled with vehicles all running as nearly as may be at one rate, but since it will be impossible to make this adjustment of speed absolutely perfect, and since accidental delays or stoppages may occur, it is desirable to check any vehicle or train which may approach too near the preceding train—the minimum distance behind the preceding train at which the check will be applied being called the minimum interval. The two parts of the invention relate to means of securing a constant rate of motion and a definite minimum interval—that part of the invention which applies to the securing of a constant rate of motion is applicable to all other cases of the transmission of power by electricity as well as to electrical transport.

4555. "Dynamo-electric engines." A. LALANCE and M. BAUER. Dated September 25. 4d. The principal object of this invention is the construction of a dynamo-electric machine, which is distinguished from all existing machines of this kind by the special form of its inducing and induced electro-magnets, as well as by their manner of rotation transversely to their poles. The end sought to attain was to augment as much as possible the magnetic field by the development or extension of the poles, and to bring the induced and inducing bobbins as near together as possible. (*Provisional only.*)

4561. "Secondary batteries or electric accumulators." F. C. HILLS. Dated September 25. 2d. Consists of improvements in secondary batteries and electric accumulators, and consists, first, in the use of what is termed "feathered lead" for the elements of the said batteries. The said feathered lead is prepared by melting it and then heating it to such a degree that when poured in a regulated stream from a considerable height into water the lead is brought into a very finely divided and feathery but coalescent and coherent state. In using the said feathered lead the inventor packs a quantity of it in frames, formed by preference of lead, or an alloy of lead, and furnished with proper electrodes, and he compresses the said lead in the said frames so that the feathery particles form a porous and coherent cake. He then places the frames thus packed in cells containing weak sulphuric acid, to form secondary batteries or electric accumulators, and charges the batteries by means of currents of electricity, in the usual way. (*Void by reason of the patentee having neglected to file a specification, in pursuance of the conditions of the letters patent.*)

4567. "Obtaining mechanical effect by electrical energy." E. L. VOICE. Dated September 26. 6d. Consists in the construction of electro-magnetic or electro-dynamic machines, whereby mechanical



effect is obtained without mechanical appliances for the reversion, cessation or otherwise varying the direction of currents in the said machines or in any part thereof, thereby dispensing with the use of commutators or their equivalents. Fig. 1 is an end elevation, fig. 2

a cross section, and fig. 3 a longitudinal section of the machine. A and A^1 are two flat hollow stationary bobbins placed a sufficient distance from each other to allow the shaft to rotate between them. I and I^1 are blocks of iron suitably fixed to the base, B, and which serve to hold the said bobbins in their place. D is the armature which may consist of two plates of iron halved together or it may be cut out of a solid piece, or arranged in blocks fixed to a non-magnetic disc as herein before explained. This armature is keyed or otherwise suitably mounted on the shaft so as to rotate in the bobbins A and A^1. It will at once be seen that the bar which is transverse to the wires of the bobbin will be powerfully magnetised, giving in this case N polarity on the right and S polarity on the left of the Figure, whilst the vertical bar being parallel with the current is comparatively out of action, the result being that N will be attracted upwards to iron block, I^1, and S downwards to block I, whence a rotary motion ensues.

4573. "Portable electrical apparatus for lighting gas." (Communicated from abroad by E. Arnould, of Paris.) Dated September 26. 2d. Relates to a portable apparatus so constructed and arranged that when desired a small piece of platinum foil or wire is rendered incandescent by electricity for the purpose of lighting a gas flame. (*Provisional only.*)

4580. "Decomposing alloys by electrolysis and dialysis, &c." W. R. LAKE. (Communicated from abroad by H. R. Cassel, of New York.) Dated September 26. 6d. In the treatment of metal alloys by means of electrolysis, with the object of perfectly separating the same, as in refining base bullion, it is essential, in order that the operation may be perfectly carried out, without regard to the proportional amount of the different metal contained in the alloy or bullion, that the solvent in which the alloy or bullion anodes are placed be prevented from coming in contact with the cathodes of the apparatus, so that none of the metals dissolved from the anodes shall be deposited on the cathodes. To this end the inventor combines the chemical action of dialysis with the electrical action of electrolysis, the discovery of which combination enables him to accomplish the desired result in a perfect and economical manner, as regards the separation of metals as well as the treatment of various solutions and substances used in the useful arts and manufactures, with the object of their concentration or the separation of their constituent parts or elements.

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CORRESPONDENCE.

Electro-Motors.

In reply to your remark that the conclusions that we have mathematically arrived at regarding the theory of motors are not borne out experimentally, because, as you state, our motors made on these theoretical principles deduced from analysis show an efficiency which is less than that given by machines, which according to these principles should be decidedly less effective, permit us to point out that you are mistaken in your premises. As you have stated in your table, published in the ELECTRICAL REVIEW for the 19th May, our motor weighing 36 lbs. gives out ¼ horse-power effective with an efficiency of 30 per cent., while the motor nearest to it in weight that we have tried, and which consisted of a Gramme armature rotating inside a Siemens' field-magnet, weighed 30 lbs., and had only an efficiency of 26 per cent. when giving out its maximum safe power of 0·123 horse-power; so that ours was twice as powerful, and about 15 per cent. more efficient.

As to the comparison between the De Méritens' motor weighing 72 lbs., and ours weighing 75 lbs., and in which both the power and efficiency were slightly higher in the De Meritens', it is mentioned in our paper that there are three reasons why the results obtained from the small number of tests hitherto made with this particular motor of ours ought to have been omitted from any table, and that it was only given because we desired to include all the results we had obtained while making this investigation, regardless of whether the results appeared to tell for or against our motors. The reasons are that while a considerable number of De Meritens' motors have been constructed, and, therefore, while the one of this type that we tested may be considered as being a fair specimen of their most improved form, our motor of 75 lbs. weight that was tested was the first and only one that had been completed of this size up to the date of the testing, all the motors previously made according to our patent specification having been the 36 lbs. size. After a few tests had been made at comparatively low speeds, we saw that it was possible to make two decided improvements in this motor; first, because we had tried to employ an extremely cheap form of commutator, which we found on trial introduced too much friction; secondly, because we had, for economy's sake, allowed the length of the motor to be made very much shorter than we felt was right, in fact, much shorter than was shown in our working drawings. Being aware of these defects, we saw that it was useless making experiments at higher speeds until, at any rate, the commutator had been changed. Hence, if any comparison is to be made between the two motors the comparison ought to be made for the same speeds. In that case the efficiency of the De Meritens' is far less than that given by us in the table, and hence far less than the efficiency obtained from our own motor at the same speed.

Previous to the reading of our paper we had taken steps to alter the commutator, and to have a longer motor made of the same diameter. From this second motor of this size, which has been completed since the reading of the paper, we have obtained far higher results than those given in the table, so that its superiority to other motors of the same weight will be as great as that which is obtained with our 36 lbs. motor.

With reference to our mathematical results that the lead usually given to the brushes of a motor is not that which gives either the highest power or efficiency, it may be well to quote from our paper the following results of experiments which we had made with the larger of the Gramme motors, but to which we had no time to allude in reading it:—

Lead.	Remarks.	Revolutions per minute.	Current in ampères.	Potential difference at terminals in volts.	Load on dynamometer in lbs.	Horse-power given in.	Horse-power given out.	Efficiency per cent.
— 45°	Very little sparking at the brushes	3,162	11·2	35·6	1·1	0·535	0·116	21·6
0°	Much sparking at the brushes	3,045	9	41·2	,,	0·490	0·111	22·3
— 20°	Less sparking at the brushes	3,130	10·1	42·5	,,	0·576	0·115	19·9
0°	Much sparking at the brushes	3,248	8·2	42·7	,,	0·468	0·119	25·4
— 20°	Less sparking at the brushes	3,405	9·4	42·7	,,	0·538	0·124	23·1
0°	Sparking, partly due to the brushes requiring trimming	3,147	9·0	42·9	,,	0·519	0·115	22·2
— 30°	Little sparking at the brushes	3,228	9·7	42·5	,,	0·578	0·118	20·4
0°	Much more sparking at the brushes	3,181	8·2	42·5	,,	0·469	0·116	24·9

* As the brushes were observed to be not making as good contact as possible with the commutator they were here taken off and trimmed, and the experiments repeated.

A negative lead means a lead in the direction of the lead ordinarily given to the brushes in a motor.

From an examination of the potential difference at the terminals with the current sent through the motor in each case, it will be seen that for a lead of 0° there is the highest back electromotive force. Further, from an examination of the table of efficiencies it is seen that a lead of 0° gives a higher efficiency than any negative lead, and further that the greater the negative lead the less is the efficiency.

This, of course, arises from the fact, as shown also by our experiment of the reversing motor, that with the ordinary negative lead in motors the magnetism induced on the field-magnets by the magnetism of the armature opposes the magnetism induced on the field-magnets by their own coils.

You state in your criticism that you do not think it right to compare the weight of a motor per horse-power developed by it with the weight of a steam-engine, inclusive of the boiler, for producing the same power. We presume from this that you think the weight of the boiler should be excluded. But it is in locomotion that the small weight of an electro-motor is of especial importance, and many systems of locomotion, as, for example, in telpherage, which comprises automatic electric transport (the joint invention of Professor Jenkin and of ourselves) if electro-motors were not used then an engine and a boiler or an engine with some reservoir of compressed air must be carried along on the moving vehicle. Consequently, we consider that it is perfectly right to compare in each case the total weight that must be carried by the electric, or steam, or gas locomotive for the purpose of producing locomotion.

Ayrton and Perry.

May 22nd, 1883.

Telegraph Rates to South America.

Those who have for many years advocated the maintenance of high rates for telegrams passing between Europe and South America, under the impression that certain cable companies had acquired a monopoly of this business, must have experienced a rude shock when it was officially announced, on the 1st instant, by the General Post Office, that telegrams for the Argentine Republic, which had hitherto cost 16s. 4d., could now be sent for 11s. 1d. per word. Sir James Anderson very justly remarked, at the meeting of the Brazilian Submarine Telegraph Company on the 4th of the present month, that they must now have to face the opposition of the West Coast Cable, and admitted that the company of which he was then speaking had he believed the highest tariff in the world. But this opposition is not the chief danger to which the Brazilian Submarine and its sister company have laid themselves open through their impolicy.

Whilst the charges by the West Coast route were recently reduced to 13s. per word, the Brazilian and Argentine Governments have been busily pushing forward their system of land lines, and now they have been enabled to further reduce the rate on telegrams for Buenos Ayres to 11s. 1d. per word. The disastrous effects of these two new and cheaper routes being opened to the public are best exemplified by the very serious diminution in the traffic returns of the Western and Brazilian Company during the past few weeks. Had the cable companies years ago made a substantial reduction in their rates to Brazil and the Argentine Republic, rates which were all but prohibitive, they would not probably have now to face a competition the ultimate results of which it is difficult to anticipate. It was surely too much to expect that the South American public would continue to pay 16s. 4d. per word to Buenos Ayres and 12s. 4d. to Rio de Janiero when they possessed the means of having the same service performed for 11s. 1d. and 9s. 10d. respectively.

No doubt the directors will now be awakened to the gravity of their position, and will devise some practical measure in the interests of their shareholders in order to get out of this difficulty.

Argentina.

Professional Men.

The writer of the communication on professional men (ELECTRICAL REVIEW, May 12) finishes by sobbing: These things should not be so. Things have always and in every country been so. Remember Virgilius and his "Sic vos non vobis." A great pity human nature cannot be improved like a Faure's battery.

Yours faithfully,

Paris, *May 19th*. **E. van Heuten.**

The Transmission of Power to Great Distances.

In the transmission of power through a great resistance a large electromotive force must necessarily be employed; and since the electromotive force of a dynamo varies as the length of the wire on the armature, and the length of a constant weight of wire varies as the square root of its resistance, therefore it is necessary to employ a dynamo with resistances proportional to that of the exterior circuit. The work that a dynamo of a certain size or weight can perform varies as,

$$\frac{\text{E}^2}{\text{L}+\text{R}+r} = \frac{r}{\text{L}+\text{R}+r}$$

where L, R, and r equal the resistances of exterior circuit, field-magnet, and armature circuits respectively. It would thus appear that when the exterior circuit and the resistances of the dynamo have a constant proportion, that the dynamo transmits the same amount of work whatever the resistance of the exterior circuit may be, although this is the case within certain limits, yet when the resistance of the exterior circuit is very great the electromotive force of the dynamo would become so great that a short circuiting of the current would result. For in diminishing the sectional area of the wire it would be necessary to vary the thickness of the insulating material as a constant fraction of the conductor, the insulation of the circuit would therefore vary as $\frac{1}{d}$, and since the electromotive force would increase as

$$\sqrt{r} = \frac{1}{d^2}$$

(where d equals diameter of the wire), therefore the liability to leakage and short circuiting would increase as

$$\frac{1}{d^3} = r^{\frac{3}{4}}.$$

There is thus a limit to transmitting work to great distances with dynamos wound with wire of a small diameter, and when the distances become very great it would be either necessary to increase the sectional area of the exterior circuit in proportion to the length of the circuit, or to employ larger dynamos and better insulated conductors.

W. Moon.

[The rule with reference to the insulating covering would not hold in practice, since there are mechanical considerations with reference to the strength of the insulating covering which require to be taken into account.—EDS. ELEC. REV.]

Metal Microphones.

It is, indeed, a serious matter to have the misfortune to breathe a syllable of disparagement, either intentionally or unintentionally, against a man's invention. Such is the melancholy position in which I find myself, sir, all through referring to a somewhat inconsequential remark of Professor S. P. Thompson.

But I should like to assure the Messrs. Theiler that my observations were meant to apply rather to hammer-and-anvil metal microphones in general, than to any particular instrument, though their "transmitter" happened to be mentioned. I have felt some gratification at the fact that the paper read on March 8th has called attention to the subject of metal microphones and their possibilities, aside of Professor Hughes' discovery, which was neglected by all but a few experimenters, such as Messrs. Theiler—and I am glad to find that the Messrs. Theiler have succeeded so well with metal microphones of the ordinary type, through some special arrangement due to their invention and experiments. It bears out the opinion, elsewhere expressed, that metal microphones have their own peculiarities which only require studying. I confess it appeared to me that sticking and wasting of the contact "points" (I use the word as it is commonly used in speaking of microphones—that is to say, for the surfaces in "contact" which every microphone, even Mr. Theiler's, must have) would seriously impair "hammer-and-anvil" microphones of metal; and the opinion is shared by others, as Mr. Theiler will see from recent remarks of Mr. Bidwell, M. A. E. Conti, and Mr. Stroh. But I am willing to be corrected on the matter, more especially as my own experiments have given me a favourable view of metal microphones in general, and turned me into a supporter of them.

It is quite true that I had not seen Messrs. Theiler's transmitter, nor all their patents; but I had seen an illustrated abstract of their patent showing what I should call a "hammer-and-anvil" microphone. It consisted of a suspended metal ball resting against another metal contact, or contacts, fixed to the end of a block of ligneous material. The use of such a fibrous vibrator is, as far as I am aware, original, and probably has much to do with the success of Messrs. Theiler's transmitter.

These gentlemen had an idea that "I do not seem to dream even of the possibility" of gratings having been experimented with by others. On the contrary, there is no occasion for dreaming, since Professor Hughes himself has mentioned that he also tried wire gauze and failed. If he, why not another?

Remarks of this sort are easily made. For example: When Messrs. Theiler, in their 1882 patent for the transmitter, wrote:—"Hitherto only carbon contacts were known to possess the property of varying their conductivity in exact proportion to the amplitude of the vibrations imparted to them, and carbon was necessarily used in all successful transmitters. After prolonged researches and experiments we have discovered that metallic contacts made of tellurium, molybdenum, or manganese, either pure or alloyed with other metals, possess the same property as carbon, and we therefore use any of the metals named, or their alloys, in the place of carbon for transmitting speech." I say that when Messrs. Theiler wrote these words they do not seem even to have dreamt that Professor Hughes discovered in 1878 that metals as well as carbon could transmit speech in the microphone; or that Edison in 1880 patented the use of the very metals they name—tellurium, molybdenum, and manganese—as contact points in a microphone transmitter. It is nothing uncommon to hear afterwards that others had been working in a similar direction.

The interesting speculations about wire gratings, and other parts of Messrs. Theiler's letter which savour of recrimination, may be passed over.

I trust I have now given these gentlemen satisfaction and done with the matter. May their instrument multiply and replenish the earth. Without wishing to prolong this letter further, I should like to add that I am pleased to find M. Conti sharing my views upon the action of the microphone, and that he has found the repulsion between the contacts. I trust he will not misunderstand what is meant by the phrase "a silent discharge." I used the term in default of a better to express the comparatively quiet and steady discharge or flow of current through the film of air (or other fluid conductor) between the solid points, and to avoid the use of the word "arc," which is associated with the production of light and heat. The word arc has come to be used through observing the spark in microphones with carbon points; but metal microphones show that there need not be any spark or light emitted in a microphone *per se*. Indeed, I believe Mr. Stroh has also observed that with carbon microphones the "arc," before seen, disappears when speaking is going on (*see* ELECTRICAL REVIEW for April 28th, p. 350). In both metal and carbon microphones there must, however, be a discharge between the points, and as far as my observation goes, it must not be continuous; though, of course, it is conceivable that loud effects of sound could be got by making and breaking the discharge.

J. Munro.

Prospects of Electric Lighting.

In replying to Mr. W. Kingsland, under the above heading, in the ELECTRICAL REVIEW of May 12th, I may say that I have never attempted to refute in the slightest degree the fact that electric lighting will become a great illuminant in the near future, because I am convinced that it will. I am quite persuaded that electric lighting will *never* become a practical success all the while it is employed by speculators as a subject for gambling on the Stock Exchange. I do not think that the "speculative fever of 1882 and the present financial depression," are *necessary* phases, neither do I think that it can be explained if "studied in the light of history" unless that history is of recent manufacture.

I quite believe that most of the electric lighting companies that *exist* at present will pass away, and the sooner they do so the better for the practical development of electric lighting, but they will not do so without leaving behind them such a blot that will take a long time to erase. I will go further and say that if gas companies would, they could produce and supply electricity at a less price and greater profit than any electric lighting company extant.

I have in my possession now plans that would enable any gas works, no matter how small or how large, to produce sufficient electricity to supply towns or cities with equal facility as they now supply coal gas. If gas companies choose to take such a plan up there would be but very little chance for competing electric light companies.

Mr. Kingsland must understand that his first letter stated that he

should take up the cudgel, apparently on behalf of the companies, but his last letter differs very materially from his first, because I believe that he would not attempt to uphold the actions of electric company speculators. His views and mine are one in the main as regards electric lighting.

The experimenting carried on by the electric lighting companies most certainly has *not* produced a retrograde movement in the development of electric lighting, but, as I stated in my last letter, this is but poor consolation to those who were induced to put their money into electric lighting companies. They were unquestionably led to believe that all the experimenting had been done, and that they were only asked to put their money into a concern that would quickly bring a return for their investment; in fact it was shown that a certain system only required capital to develop it into a good paying concern, when in reality the only scheme on foot was to get the money out of the subscribers' pocket into that of the company promoters. If Mr. Kingsland can prove my statement to the contrary it is still open for him to do so. I happen to know the opinion of many of these men, and having had a little experience of them enables me to speak from what I *know* and not from what I believe.

Six years' experience in a gas works enables me to state with confidence the practicability of their undertaking the supply of electricity —bear in mind not from a monopolising point of view, but from the suitability of their plant for practical operation, for the production of electricity at a price that would pay them to sell and the customer to buy.

I feel confident that the time is fast approaching when electricity will have to be supplied as an agent for light and power, and if the many electric light companies will not or cannot give that supply then the gas companies must, and thus add a still greater increase to their already large dividends.

A. J. Jarman.

London, *May 19th*, 1883.

The Gramme Ring.

In your description of Ball's dynamo-electric machine, and on previous occasions, you alluded to what I have always considered the true theory of the action of a Gramme ring, the simple explanation being to me that of a wire helix passing over the poles of a magnet—the iron ring being polarised by the field magnets—and that all the wire outside and inside the ring contributes equally, or nearly so, to the general effect in producing the current. That the inside portion of the wire may not be quite so efficient as that on the outside is due, no doubt, to the fact that the space in which it is wound being smaller than that outside the ring the wire is more cramped and the outer convolutions are further away from the iron ring than those on

FIG. 1.

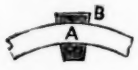
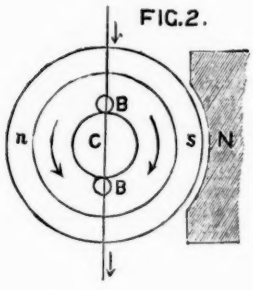


FIG. 2.



the outside. Fig. 1 will probably make my meaning more clear, where A is a portion of the ring and B is one section of wire which necessarily in the winding projects further from the ring inside than it does outside. I have recently noticed in a contemporary several letters bearing upon this subject, and the majority of the writers agree that the current is produced by the *outer halves* of the wire section cutting the magnetic lines of force. If this latter theory be accepted I should be glad to see it applied to Ball's machine. This has but one pole piece to the whole ring, yet, as you have already shown, the current in *each half* of the ring is about equal. Where, however, are the lines of force on the side of the ring *furthest* from the pole and how is the current developed wholly in the *outer halves* of the wire sections on *that* side? Figure 2 will perhaps illustrate that which I try to show. N is the pole piece of the field-magnet, *n* and *s* the magnetised halves of the ring, which may not however have their neutral line *exactly* through the centre as I have drawn it, C, the commutator, and B, the brushes.

How in such a case as this can the last theory I have mentioned be reconciled with the action which takes place? Is it not time that some of our electricians should disabuse all our minds as to the doubts which evidently exist at present?

A Constant Reader.

Tests of Incandescent Lamps.

I should like to ask Mr. H. F. Joel whether there is not some mistake in the figures given by him in your issue of the 19th inst., in reference to the test of 15 Gatehouse lamps. Taking the resistance at 96 ohms cold, and multiplying it by ·55 to ascertain the resistance hot, which I think is an ample allowance for the decrease of resistance by heat, the Gatehouse lamps would, when hot, have a resistance of 52·5 ohms; thus, with a current of 49 volts potential, the ampères would be 0·93 instead of 1·05 as stated. It may be that these lamps have a peculiarity of their own; should such be the case, then it is very desirable that the resistance hot should be given as ascertained by actual experiment.

Fredk. H. Varley.

Mildmay Park Works, Mildmay Park, N.

Long-Distance Telephoning.

In your comments upon my statement in regard to trials of the L. & B. telephone through resistance coils, published in the Review of 19th inst., you are pleased to say—"Mr. Barney should know that a resistance coil of 25,000 ohms used for a laboratory test, is entirely different to a telegraph line, and his experiment is therefore of no value whatever." It seems clear that your words do not express what you intended to say, for surely you cannot suppose that any person would think a resistance coil to be identical with a telegraph line, but such in fact is the true meaning of your language. No doubt you intended to state that the results obtained in a laboratory through a resistance coil are no criterion by which results in a telegraph line *per se* can be accurately determined. It is now nearly forty years since I fully appreciated the difference between results obtained in a laboratory and those on a telegraph line, when I was assisting Professor Morse in his first trials of his telegraphic system between Washington and Baltimore. I may have loosely stated, but I do not think I have, my meaning, but you have certainly not seized upon it.

I will endeavour to explain my meaning.

In your Review of the 7th April, you write that "the instruments used in telephoning a distance of 1,000 miles contributed little, if any, to the success obtained," and in the Review of May 12th, you write "the success was due to the conductor solely," the conductor used being of a very high conductivity, the resistance being about one-tenth that of an ordinary telegraph line of the same length. In my letter in the Review of 12th inst., I stated that the resistance of the line, *leakages included* (not the resistance of the metal conductor only), was 1,522 ohms, and as the earth was used for one-half the total circuit, the 1,522 ohms represented the *total* resistance of the circuit, *leakages included*.

If, then, it be true that long-distance telephoning, as you say, depends *solely* on the conductor—that is upon a conductor of very low resistance—I must insist that my experiments with the L. and B. instruments through resistance coils of 25,000 ohms are not "*of no value*," as you are pleased to say, because these experiments prove that they are capable of telephoning through a total resistance of 25,000 ohms. It matters not wherein lies the resistance of the circuit, whether it lie in a metal conductor perfectly insulated, or in an ordinary telegraph line with all its leakages, because the difference of potentials between the two ends of a conductor with a given battery must always be the same, when the total resistance of the circuits are equal, whether such resistance is caused by the low conductivity of the conductor, or by leakages from a conductor of a high conductivity. By the total resistance of the circuit I mean that resistance united with the derivations of the current which tends to diminish the potential at the receiving end.

I must deny that long-distance telephoning, or rapid telegraphy on long lines, depends solely on the high conductivity of the conductor because of earth currents when the earth forms part of the circuit, and also from what has been termed retardation of the current, both of which effects interfere materially, especially with rapid telegraphy over long land lines and submerged cables. It is very evident, however, that what is called retardation of the circuit does not present so great an obstacle to long-distance telephoning as to long-distance rapid telegraphing, although telephoning requires many, many times more impulses of electricity to pass over a conductor in a given time than the most rapid telegraphing hitherto accomplished does, the limit of the length of a conductor through which the impulses or rather variation of intensity of a current necessary to reproduce articulate speech can be sent, remains unascertained. In regard to rapid telegraphy, I may be permitted to state that in March, 1875, on the Belgian Government telegraph wires by my system of chemical telegraphy, with my instruments made by Breguet, of Paris, 450 words a minute were sent between Ostend and Brussels, certified to by the Director-General of Belgian Telegraphs, and on the 17th July, the same year, 1,002 words were sent in one minute from Ostend to Brussels; the whole despatch was read by the employés present.

I beg to repeat that my tests in my laboratory of the L. and B. telephone through 25,000 ohms are not "*of no value*," because this proves that those instruments will repeat articulate speech over a circuit, the total resistance of which, inclusive of leakages, does not exceed 25,000 ohms, provided earth currents or retardation do not interfere. This last proviso I put in, although you made no reference to it, but simply claimed that the success of the telephoning over 1,000 miles was due "*solely to the conductor*."

I hope to be able shortly to send you an authentic account of the long-distance telephoning between New York and Chicago, giving all the data as to battery, &c.

W. C. Barney.

May 21st, 1883.

[It appears useless to waste any further arguments with our correspondent, therefore we will only *assert* that the difference of potential between the two ends of a conductor under the two conditions quoted is *not* the same. With reference to the last paragraph the statement amounts to this, that a circuit whose total conductor resistance is 50,000 ohms would, with a leakage in the *middle* amounting to "dead earth," still enable articulate speech to be transmitted to the further end, since the total resistance in this case would be 25,000 ohms.—EDS. ELEC. REV.]